THE MONONGAHELA BRIDGE.

Rebuilding of the Monongahela Bridge, at Pittsburgh, Pa.

BY G. LINDENTHAL, M. AM. SOC. C.E.

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Condition of Old Suspension Bridge before Removal; Tests with Iron from the same, and Conclusions.—As remarked before, the old superstructure was loose and undulating up and down about 3 ft. in each span.

The Howe trusses at the ends of the floor beams were intended to give the required stiffness to the suspended platform, but they had become very pliable, and remained so in spite of the efforts on the part of the bridge repairers. "The splices would not hold." Nor was the cause difficult to discern.

Every passing load would deflect the wooden floor beams and raise their ends, the suspender from the cable acting as a fulcrum. At the ends of the floor beam was the Howe truss, which in this way was lifted up for a certain length. Hence, instead of distributing the load on the cable, it had just the reverse effect; it would increase the load on a suspender by its own weight for the length of several panels.

When in addition, the suspenders were badly adjusted (and it was no easy matter to adjust them right), the unfavorable conditions were still more increased. The bridge repairers had tried hard to make the Howe trusses do their duty, especially as the Bridge Company had to pay a handsome yearly pate t royalty on the same, but in vain. Their value as stiffening finally consisted in their dead weight, about the most harmless service that could be expected of them in their position on the bridge. Nor was it surprising that the suspender rods from cable to floor would constantly break.

There were few days when no rods broke, and sometimes as many as eight broke in a day, mostly only the the short suspenders (under 4 ft.), which in addition to the pull from the load and the action of the Howe truss, were subject to alternating bending strain from the vibratory motion of the floor at and near the middle of the span.

The size for the short rods had been gradually increased from 1⅛ in. to 1¼ in. diameter and steel had been tried for them. But experience proved that a soft, tough iron would last the longest: they invariably broke at their lower end in the thread behind the nut. If one of these rods lasted two years it was considered very good iron. Soft steel rods last about four months. The stays 1¾ in. in diameter had also become loose and useless.

The bridge, with a series of eight suspended spans afforded the opportunity of observing the effect of an advancing load upon the cables when the bridge otherwise happened to be free from teams. The loaded span would, of course, deflect, and the neighboring spans would rise. The movement in the floor seemed to the eye like an advancing wave, requiring a certain time to reach the anchorages. It strongly suggested the element of time required for a force to produce its full effect on a continuous bridge frame of greater length, whether it be a number of connected smaller spans, or one or more of greater span. Even in a suspension bridge in which a stiffening truss of sufficient strength and in the plane of the cable equalises the load on the same, the exact strains in both are not easily defined. For a uniform load, for instance, the stiffening truss is not needed, the material in the same is not strained, but the cable has a certain permanent strain. If now a partial load is to be prevented from deforming the cable, by means of a stiffening truss, the material in the same will be strained from zero to a certain maximum in certain places.

If we consider that the lengthening or shortening of the material takes places in an exact ratio with the strains which cause these changes of length (within the elastic limit), and that the time required for them is necessarily in the same ratio (since the strains are caused by the same load), then it follows that the full effects of the load on the trusses and on the cables take place at different times. For when the material in the trusses from the above partial load is strained from 0 to, say 16,000 lb. per square inch for steel, the strains in the cable will, (we assume) be raised from 12,000 lb. to 14,000 lb.; the ratio of the increase would be as 8 to 1.

(The ratio here assumed is dependent on length of span, and becomes greater as the spans gets longer and proportionately heavier. No allowance is made in this illustration for the time required by the force to travel up the suspenders to the cable.)

In other words the maximum effect will be produced in the cable eight times quicker than in the stiffening truss. The deforming force will travel that much faster in the cable than in the stiffening truss, whatever the absolute time may be.

In this wise the writer would explain the observed movement of the cable in advance of the movement of the floor and trusses on the unloaded bridge, from a team advancing on it.

The cable would, on the entering of the load on the bridge, at once commence to move from end to end of the bridge, and the grinding noise of the moving pendulums could be heard long in advance of any noticeable deformation in the floor or Howe truss. The cables were at the middle of each span close down to the floor, which could not move longitudinally. When the "advance movement" in the cable from a load occurred, the short suspenders, at the middle were almost the only means of checking the extent of it; these short suspenders were subjected to a severe bending strain, as mentioned before, and would break off frequently.

Such effects of loads on a stiffened suspension bridge should receive consideration in designing the same; the writer's investigations in that direction convince him that stiffening trusses, if they were properly proportioned, are the least economical means in point of material of giving rigidity to a suspension bridge, even for longer spans, in which the inertia of the mass itself contributes to stiffness, and where the deforming loads are but a fraction of the permanent ones.

Loads coming upon the bridge in the form of shock did not seem to affect the cable much. A wagon jolting over defective rail joints would cause severe shocks on the suspenders, but near the cable ends it could hardly be felt.

On taking down the bridge, an opportunity was offered to examine the iron of some bridge parts which had been severely strained for thirty-seven years.

The only tests which had been made by Mr. Roebling were with the wire, which had been tested with an ordinary lever beam to 1200 lb., and also by bending it repeatedly. So the writer learned from Colonel S. M Wickersham, in Pittsburgh, Pa., who had been Mr. Roebling's superintendent in building the Monongahela Bridge.

The old cable had 750 wires, consequently a strength of 450 tons.

The writer's calculations show that the pull in the cable, from the dead load alone, was 94.2 tons at the middle, and 98.0 tons at the ends; and from ordinary daily loads, 175 tons at the middle, and 186 tons at the ends; from heaviest loads admitted, and occurring several times a week, 245 tons at the middle, and 256 tons at the ends.

This shows that the wire was daily strained to ⅓ and frequently to over ½ of its ultimate strength. Still, on taking wires from the cable, some of them would coil up, presumably to the curve they originally had on the wire drum. "There was still life in them." Ten wires from different parts of the cable were tested in Pittsburgh, and showed an ultimate strength of from 990 lb. to 1340 lb., equal to 72,700 lb. and 95,700 per sq. in.

The lowest result (72,700 lb.) was with a wire from around the cast shoe on the pin. The elastic limit was from 67,100 lb. to 78,600 lb. per sq. in. Ten similar wires were sent to Mr. Collingwood, assistant engineer at the Brooklyn Bridge, and tested by him. Strange enough, the strongest wire there was from around the shoe, showing an ultimate strength of 100,000 lb. per sq. in. The weakest specimen showed 91,241 lb. per sq. in.; this broke outside the marks. The average of the 10 wires was 96,690 lb. per sq. in., or over 3,000 lb. more than Trautwine gives for wire of 0.13 in. diameter.

Mr. Collingwood's results are somewhat higher; it is probable that this may be on account of the different testing machines. The elongation was from, 1.66 to 8.5 per cent. Reduction at point of fracture was from 35 to 75 per cent. A new ordinary telegraph wire of same gauge, tested in Pittsburgh, showed an ultimate strength of 99,980 lb. per sq. in.; elastic limit, 81,550 lb.; elongation, 5¼ per cent.; reduction, 57.4 per cent. The wire splices were 3 in. to 4 in. long, and consisted of the overlapping wire ends being wrapped closely with fine annealed wire. Three of them were tested; they all broke in the splice with 980 lb., or 1,010 lb., and 1,030 respectively, or somwhat less than the full strength of the wire. The same could be bent to 180 deg., back again 360 deg., and would break then in straightening up.

The above tests proved that the cables had lost little if anything of their original strength.

One end of each cable was fastened to the pendulum pin with four eye-bar 4 in. by 1¼ in., and about 2½ ft. long from centre to centre of holes for 3-in. pins. The connection is shown in the sketch.

The total section of the four bars was 20 sq. in., and assuming that they were all strained alike, the pull on them from dead load alone was 98 tons, or 9,800 lb. per sq. in.; from ordinary loads was 186 tons, or 18,600 lb. per sq. in.; and maximum was 256 tons, or 25,600 lb.

But from the arrangement of the bars it is apparent that the inner cable links had to take the greatest share of the pull, and before the pins had bent, must have had to resist the entire pull.

The iron in them was consequently strained far beyond the elastic limit, and they had stretched ⅛ in. to ¼ in., as was ascertained by measuring the length of the inner and outer cable links. The 3 in. pins were all found to be bent, and two of them were found to be partly broken in old flaws.

The strain in extreme fibre from bending on the pin, by the pull of the cables from dead load alone, could not have been less than 46,500 lb. per sq. in., and 90,000 lb. from ordinary loads, or about 4½ times as much of what is considered safe practice in modern iron bridgework. The cable fitted over the pin with a cast-iron shoe which in most places was found broken.

The pendulum pins, on which both cables were fastened, were also all found to be bent; in all of them grooves had been worked out from the motion of the pendulum. The grooves were ¾ in. to ¾ in. deep; the corresponding pin-holes in the pendulum bars had been ground out to an oblong shape to the same extent.

Three pins were tested and bent on an anvil to ascertain the character of the iron; one pin broke clean off at a bend of 30 deg., revealing a granulated fracture of fine grain on the convex side and a coarser grain on the concave side.

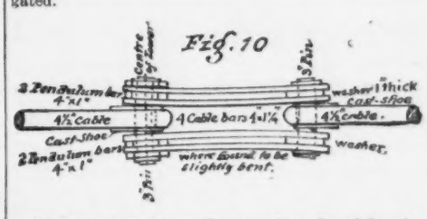
The second pin broke in bending through a hole in the outer fibre, which was fibrous and crystalline in layers. In the hole was found a steel plug ¾ in. long.

The third pin gave the most surprising result. It bent 180 deg. around two-thirds of its diameter without any crack. It had 4 groves ½ in. deep worked out from the pendulum bars.

All pendulum bars were 4 in. by 1 in. in section, or 4 sq. in. per pendulum. The pull on them was, from dead load alone, 56.4 tons; from ordinary daily loads, 106 to 146 tons. Supposing the bars to have been strained all alike, the pull per square inch, from dead load alone, was 3.5 tons, and from live loads 6.6 to 9.2 tons. But owing to the bars being in pairs at each end of the pin, the inside bar had necessarily a larger pull to resist, and must have been strained sometimes to 15 tons per sq in. In addition to it was the torsion and friction on the pin.

The bearing strain on the lower pin-holes of the cable links was 6.5 tons per sq. in. from dead load alone; and from live loads it must have often reached 12 tons to 22 tons per sq. in. But there was no motion on these pins, and they showed no marks or grooves, notwithstanding the great compression of the metal; neither were the corresponding pin-holes in the eye-bars elongated.

Fig. 10



The bearing strain on the semi-intrados of the pin-hole (3 in. by 1 in.) was for dead load 4.67 tons per sq. in., and for live loads must have reached 8.8 tons to 20 tons per sq. in. Present practice would allow 7.5 tons maximum.

The section of the anchor chains on both abutments was equal to four eye-bars of 4 in. by 1½ in., or about 18 sq. in.

The pull on these bars, from dead load alone, was 56 tons, and from ordinary live loads 106 tons to a maximum of 144 tons, representing a pull per sq. in. of 3.1 tons, 5.9 tons, and 8 tons respectively.

The suspension rods 1¼ in. in diameter (1.15 sq. in.), had to resist a pull of 2,000 lb. to 13,000 lb. each. A great many of the shorter rods broke in the thread under the nut (net area, 0.7 sq. in.), and were replaced with 1¼ in. rods, as mentioned before. The cause of the breakages has also been stated.

The fracture of every broken suspender was granular of finer or coarser grain. In bending the same rod a few in. above the fracture, it would reveal mostly a fibrous texture, showing that deterioration had taken place at points of overstraining.

The stays in the old bridge were without strain, and had been so many years; where the loose stays crossed the suspenders, the former were worn sometimes ⅜ in. deep; the suspenders were worn but slightly at these crossings. Bending tests with these stay rods showed a ductile tough iron.

A number of tests were made with eye-bars from different parts of the bridge, with stay rods and suspenders, the results of which are tabulated elswhere

Conclusion from Tests.—The high elastic limit of the cable wires, sometimes so close up to the ultimate strength as to be impossible to define, and the small elongation, together with the large reduction, have been undoubtedly the result of the cold drawing of the wire, which generally has the effect (the same as in cold rolling) of raising the elastic limit and ultimate strength, bringing them closer together, and reducing the elongation. In the texture the iron was made steely and homogeneous.

The pliability of the cable protected the connections in the towers (which were the weakest parts) from shocks. Otherwise, the cable links and pins, overstrained as they were, would have parted under a sudden pull long ago; as it was, all of the pins were found bent, and some partly broken.

Two of the cables, after having been in the river six months, were found to be dry in the inside, so well had the old wrapping and paint protected them. The danger from rust is thus little more for the metal in cable form than for a solid bar, while the former is fully twice as strong. Steel and iron are strongest in the wire form.

The advantages of the cable form for tension members in long spans are indisputable, and the judgment of Mr. J. A. Roebling (the originator) is fully corroborated by experience.

In the absence of any recorded tests with iron bars at

the time of building the bridge, the conclusions from the tests stated above will be, necessarily, incomplete; but this much can be said:

That the iron put in the bridge originally was not of a uniform quality. The bending tests on the pins and the fracture of the eye-bars prove this.

Of three pins which had been bent, each one showed a different quality of iron and texture, though they had been subjected to precisely the same strains in the bridge. The pin, doubled up in bending, proved, after being severely strained for many years, to be of a superior ductile iron, the fibrous texture of which had not been changed in any way. These pins were not an anchor-bar as the one before mentioned, in which the full strength (45,790 lb.) of the iron was developed, showed a high elastic limit (30,050) with an elongation of 9.6 per cent., a quality of iron which is often accepted now-a-days for plates. The fracture was fibrous, with few crystals.

In all the rest of the tested eye-bars the ultimate strength of the iron was not developed, owing to the weak heads, which were all too small, and broke in testing. The smaller heads broke in all bars; the fracture was crystalline in some and fibrous in others. One of the bars after being nicked, would not break, but bent and showed tough iron.

TESTS WITH OLD IRON EYE-BARS.

Positions of Bars in the Old Bridge.	Normal Section.	Area of Bar.	Length of Bar, Back to Back of Holes.	Excess of Area in Head over Bar.	Elastic Limit of Bar Pounds per Square Inch.	Elongation of Bar in Per Cents.	Fracture occurred at following Strain per Sq. In. of Bar.	Remarks.
	in	sq. in.	ft. in.	per cents.				
Pendulum, inside link	4×1	4.0	2 8⅞	$\{a = 12.5, b = 6.5\}$	..	3	34,850	Fractured in eye *b* before elastic limit could be ascertained. Crystaline appearance. Both pin holes worked out ⅛ in.
"	"	3.87	2 8⅛	$\{a = 15, b = 14\}$	31,330	6.9	47,350	Broke in eye *b*, with fibrous fracture. Both pin holes worked out ¾ in.
" outside link	"	3.73	2 8	$\{a = 16.3, b = 17.0\}$	34,000	5.3	40,840	Broke through pin hole *a*. Crystaline fracture. Both pin holes worked out ⅝ in.
Cable bars, inside link..	4×1¼	5.15	2 10	$\{a = 19, b = 25\}$	26,740	8.0	41,770	Broke through the eye *a* with a steely granulated fracture. Round pin holes 3 in. in diameter.
" outside link.	"	5.10	2 9⅛	$\{a = 17, b = 19\}$	31,530	10.3	44,140	Broke in eye *a* with a fibrous fracture. Round pin holes 3 in in diameter.
Anchor bars, north abutment.	4×1¼	4.4	11 4½	$\{a = 27.7, b = 30.0\}$	33,090	2.92	42,230	Broke in the bar with an entirely crystaline fracture 5 ft. from end. Round pin holes 3 in. in diameter
" south "	"	4.52	10 9½	$\{a = 13, b = 16\}$	29,850	6.0	40,760	Broke through the eye *a*. Crystalline fracture.
" " "	"	4.67	10 9	$\{a = 18, b = 19\}$	30,050	4.7	39,230	Broke through the eye *a*. Crystalline fracture.
" " "	"	4.54	12 2¼	$\{a = 22, b = 31\}$	30,280	9.6	45,790	Broke in the bar 4 ft. from the end. Fracture mostly fibrous. Few crystals.
" " "	"	4.84	12 2¼	$\{a = 25, b = 31\}$	28,930	1.1	32,150	Broke in the bar through an old flaw. Fracture crystalline and fibrous in layers.

A cable bar 2 ft. 10 in. long back to back of holes was nicked in the middle of the bar and bent; it would not break; it bent to a horseshoe 8 in. in diameter.

A pendulum bar 2 ft. 8 in. long back to back of holes was nicked in the neck of the eye and partly bent; it would not break at a right angle; a partial fracture showed fibrous and crystalline layers.

TESTS WITH OLD IRON RODS, USED AS STAYS OR SUSPENDERS.

Position in Old Bridge.	Nominal Section	Area of Bar.	Normal Length of Specimen.	Elastic Limit per Square Inch.	Elongation in per Cents.	Ultimate Strength per Square Inch.	Reduction at Fracture in per Cents.	Remarks.
	in.		in.					
Stay rod, mostly without strain in the bridge.....	1¼ dia.	1.37	8	28,570	35	48,600	52.8	Fibrous fracture.
Ditto ditto	"	1.375	8	27,270	18.75	43,770	..	Fibrous fracture occurred at a worn portion of specimen.
Ditto ditto	"	1.352	8	26,380	13.87	49,720	..	Fibrous fracture broke in the grips.
Ditto ditto ...	"	1.375	8	29,290	33.75	48,000	55.6	Fibrous fracture.
Original suspension rod.	1¼ dia.	1.158	8	25,710	8.75	48,380	8.8	Entirely crystalline.
Ditto ditto	1¼ "	1.15	8	22,590	18.75	Fractured in. occur'd at 46,150 46,820	..	Crystalline and fibrous in layers.

only subjected to a very great bending strain, but also to torsion and friction.

The iron in the bars shows also a want of uniformity, which must have existed originally, which is plausible, considering the difficulty of making them in 1845. Each link seems to have been forged from one billet; this is supposed from the variation in their section, not only as one compared with the other, but in the same bar. Most of the bars were full of slight flaws crosswise and lengthwise, suggesting the use of a light hammer and want of sufficient power to condense the metal, especially in the eyes, where the largest mass was. The fibrous fracture in some eyes, and the crystalline fracture in others, belonging to the bars that have been exposed to like strains, proves that the crystalline texture must have been there originally, and was not the result of deterioration.

Of ten eye-bars tested, only three broke in the bar—one of them through a flaw—so that only in two bars the full ultimate strength of the iron was developed in testing. It reached 42,230 and 45,790 per sq. in. respectively. The former was of crystalline texture, had a high elastic limit (33,090) and low elongation (2.92 per cent.); it was an anchor-bar, on which the strain per sq. in. probably never exceeded 12,000 lb.; furthermore it was never exposed to the slightest vibration in the bridge.

It is reasonable to assume that the bar was crystalline in texture when put in place. The other eye-bar, also

The iron in the cable bars has been undoubtedly often strained beyond the elastic limit. As to the proportion of the heads to the bar, the tests show that where the excess of metal was below 22 per cent. the eye broke without developing the full strength of the bar.

The original want of uniformity in the iron is also attested by the tests on the suspension and stay rods. None of them were strained more than 12,000 lb. per sq. in. The fracture with crystalline and fibrous layers shows that the iron had been so put in the bridge originally. If deterioration would affect a fibrous texture it would be destroyed.

The above tests indicate that iron highly strained for a long number of years, but still within the elastic limit, and exposed to slight vibration, will not deteriorate in quality.

That if subjected to only one kind of strain it will not change its texture, even if strained beyond its elastic limit, for many years. It will stretch, and behave much as in a testing machine during a long test.

That iron will change its texture only where exposed to alternate severe straining, as in bending in different directions. If the bending is slight, but very rapid, as in violent vibrations, the effect is the same. (Mark failure of short suspension bars.) The deterioration may be explained as a loosening and destroying of the fine lamine of slag (in the fibrous wrought iron) causing the same to become granulated. In a fibrous iron the cohesion of the molecules is greater in the direction of the fibre than across it. When the dividing laminæ of slag are destroyed, the iron particles tend to restore an equilibrium of cohesion, as it were. Their cohesion longitudinally decreases and transversely increases, causing a condition of cohesion as in cast iron.

Another such agency, changing the texture of iron, may be found in heat and oscillation combined. Latent heat may be evolved by violent continuous vibration itself. It seems certain that crystallization cannot take place unless the iron softens sufficiently under heat, and has rest to form crystals. Iron found to be crystallized, has either been so originally or has been made so by sufficient heat and rest in one form or the other.

The old bridge did not have any wrought-iron members in compression. The cast-iron towers, the only compressed members, had 96 sq. in. section. The cast iron was never higher strained than 2,000 lb. per sq. in. under most unfavorable conditions of loading. It was fine-grained and tough.

Two cast anchor-plates only were removed; one of them was found with an old flaw through the entire width. It was taken from the ground whole, but in turning over and falling it broke, revealing the old flaw. It is very probable that on account of the friction on anchor chain the full pressure against the anchor plates had never been exerted.

The iron test specimens from the old bridge were exhibited at the International Exposition of Railway Appliances in Chicago, in June, 1883, and afterwards donated by the writer to the Western Society of Civil Engineers.

The lumber, thirty-seven years old, in some parts of the bridge, where it was protected against rain and sun, was found to be still in excellent condition.

Building and Pavements in Mexico.

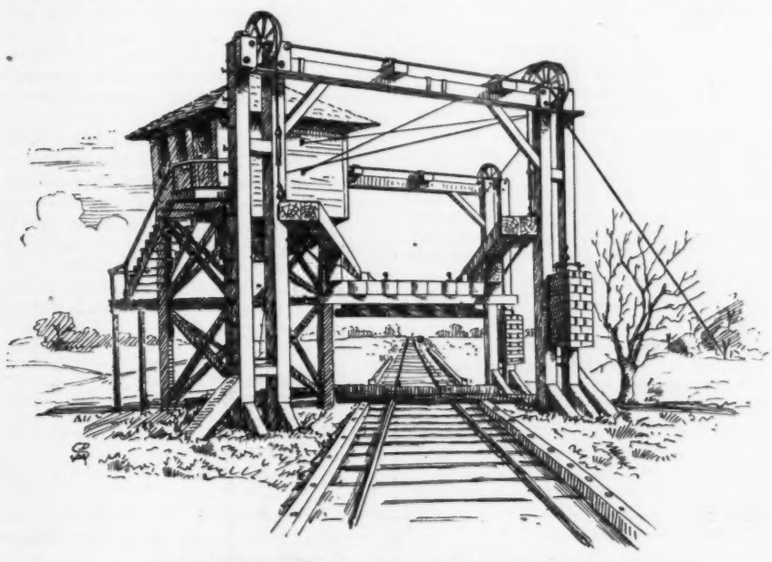
While there are no thirteen-story, or even five-story buildings in Mexico, stone structures two, three, and even four stories high, prevail in the central business quarters. Most Americans coming here will be surprised, I fancy, to find that there are streets as handsome, as substantially built, and as full of wealth as the average thoroughfares of commerce in large cities at home. Mexico is no mushroom growth. Its universal stone is handsome and its air of solidity is extremely pleasing. Humboldt's admiration for the breadth of Mexican streets, however seems odd. Compared with American urban thoroughfares, save those of the older parts of Boston, they are very narrow. A railway track and two carriages will fill the space from curb to curb in more streets than one. The sidewalks are ludicrously narrow. It is sometimes impossible for two persons to walk abreast, and four arm-in-arm would monopolize the breadth of most of them. But the pavement of the driveways is generally clean, and no one hesitates to go in the road if there is no room on the walk.

The central streets are paved with stone blocks, not quite cobble stones, nor yet of comfortable size. They are ill laid, and it is rough riding on them. Indians water the streets by hand, as well as sweep them with little whisk brooms, the brush tied in the middle without a handle, so that both side are available. It is a wonder that street-sweepers survive an hour of their back-aching work. The Indian endurance is deservedly famous. It is a comical sight, this sweeping and sprinkling by hand with a basin full of water at a time. On the broader drives one will see half a dozen stout fellows laboring at an old-fashioned hand fire engine pumping water through a hose upon the thoroughfare. There are modern watering carts in town, but judging from the appearance of things to-day, they will not be universally employed for an age.—*St. Louis Globe Democrat.*

IT is a remarkable fact that from the introduction of the flint-lock in 1635 to that of the percussion cap about 1830—a period of nearly two hundred years—no improvement whatever was made in the fire-arms of infantry troops. The British fought at Waterloo with the same arms they used at Blenheim. Three regiments with breech-loaders under Napoleon at Waterloo would have caused history to be written in a very different shape from w t is now recorded.

Lift Bridge over Pennsylvania Canal.

A Lift Bridge has been recently designed and constructed by Wm. H. Searles, C. E., for the Beech Creek, Clearfield and Southwestern Railroad, at its crossing of the West Branch of the Pennsylvania Canal near Jersey Shore, Pa. The railroad company had already decided on a low grade crossing, with the base of rail 4 ft. 3 in. above the water surface, when Mr. Searles undertook the present design. The canal company required a clearance of 3 ft. from the water to the underside of the bridge, to provide for the passage of rafts when the bridge is closed, leaving, therefore, only 1 ft. 3 in. of vertical space in which to sustain the track. This condition made a deck bridge impossible, and necessitated widening the floor to 10 ft. 10 in. in the clear, for a low truss through



LIFT BRIDGE OVER PENNSYLVANIA CANAL.

bridge. The skew of the bridge is 36° from a right angle. The span over the boatway is 27 ft., with 12 ft. additional for the tow path on the railroad line,

Two designs for this crossing had been previously made by other parties and rejected. The first was for a hinged lift bridge, rising at one end only; the other was for a swing bridge 75 ft. long. Both these designs were for wood. Several bridge companies were applied to for designs in iron. Only two responded, while the prices proposed, made necessarily at a high figure on account of the difficulties involved, did not meet the views of the company. The bill of timber for the wooden swing design had been ordered and delivered before it was decided to set aside that plan; in consequence of which the present design for a bridge lifting simultaneously at all four corners, was arranged in part to utilize the timber on hand as far as possible.

The general appearance of the structure is shown in the accompanying view, copied from a photograph. The chords are of white pine 14″ × 14″. The interval between chords is only 9 in., since the narrowness of the bridge compelled the top of the trusses to keep below car bodies. The span proper consists of nine panels of 3 ft. each. The brace and counter-brace of each panel is consolidated into a single block of pine 14″ × 14″ × 1 ft. 6 in. long. These are panel blocks. They are not keys. The grain of the wood is parallel to the truss, the corners are bevelled off at 45°, and these bevelled faces receive all the diagonal thrusts. The panel rods pass through the chords and also through the floor-beams, supporting the latter. There are also intermediate floor-beams which are supported by bolts from the top of the panel blocks. The floor-beams are of white oak 8′ × 12″.

In framing the bridge the panel blocks were first let into the lower chord, and bolted permanently to their places. A camber of ¾ in. was given to the lower chord; the top chord was then laid on and scribed for the panel blocks, and after being boxed out was again put in place and the panel rods passed through. When the bridge was swung and tested with a consolidation engine it proved very stiff, and after removal of the load the loss of camber was hardly perceptible. To save weight in the structure, the bridge proper was limited to the requirements of the water way, only the upper chords being extended over the tow path somewhat like barrow handles. The length of the lower chord is 33 ft.; of the upper chord 51 ft. 6 in. The bridge, when raised, is suspended in a horizontal position by wire ropes attached by means of hooks and links to heavy pine blocks, bolted to the extremities of the upper chords on the outer side. The blocks serve to increase the space between the suspending ropes, and give the necessary clearance to trains. The upper chords are secured against undue deflection under the pull of the wire ropes by iron eye-bars extending from the points of attachment diagonally, downward and inward, to pins passed horizontally through the lower chords. These bars also prevent any twist in the upper chords under the side strain of the ropes. The pins at either end of the eye-bars pass through half-inch iron plates, which receive a large part of the strain and distribute it to the wood by a number of large lag screws.

The wire ropes pass over cast-iron sheaves mounted on shafting, and terminate in counter weights. The sheaves are 42 in. in diameter, and have 4 turns of a spiral groove on the face in which the rope lies. The shafting on the tow path side is in two lines, connected by reversing pinions. The same is true on the berme side, the reversing motion being necessitated by the skew of the bridge in order to keep the counter weights clear of the trains. The shafting on either side of the canal is connected with the other by a wire rope passing over sheaves, and made "endless" by a turn-buckle so placed as to afford the necessary travel without coming in contact with either sheave. The shafting is supported on bents of four posts each firmly braced at the bottom and overhead, and further secured by light guy-rods.

On the berme side there is a wooden tower 14 ft. square and 28 ft. high, only the upper part being inclosed. This contains a train of spur gearing terminating in a hand crank, by which the attendant operates the machinery and lifts the bridge.

The counter weights are of cast-iron blocks weighing 100 and some 200 pounds each. These are hung in cages formed of vertical rods spaced apart, top and bottom, by suitable flat bars. Owing to the different distances of the points of suspension from the center of gravity, no two counter weights are alike, but are respectively, on the tow path side 4,200 and 7,200 pounds, and on the berme 6,600 and 8,600 pounds, giving a total of 26,600 pounds. The lifting portion of the bridge is very nearly in equilibrium with this counter weight, so that in lifting the bridge only the friction has to be overcome.

The extent of the lift is 9 ft., time required for the operation 25 seconds, with one man at the crank.

To secure the bridge to the seat when closed, a ratchet is placed on the crank shaft in which a pall engages, allowing the bridge to descend but preventing motion in the opposite direction. When the bridge reaches the seat, the man in charge gives one extra partial turn exerting his whole strength for a moment, thus slightly raising the counter weights, while the bridge settles heavily to its place.

The bridge is guided during its motion by straps of iron secured to the posts on either side the canal, while wedge-shaped blocks on the abutments direct it positively to its proper place during the last few inches of its descent, so that the rails form an ordinarily close joint in good alignment when the bridge is closed. Flaring chairs of wrought-iron at the ends of the rails, serve also to receive the descending rails and preserve the alignment. The rails on the lifting portion are 32 ft. long, reaching from center to center of the back walls. They were rolled of this length specially for the bridge.

The erection of the bridge and tower was assigned by contract to A. F. Chapman of Watkins, N. Y., who is doing a large amount of work for the same company. The machinery and other iron work was furnished by G. S. Snyder & Co. of Jersey Shore. Pa.

The bridge was required to be ready for navigation by April 10th, it was raised for the first time on April 9th, and has been in successful operation since that time.

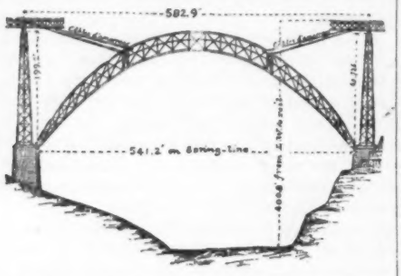
Suitable danger signals interlocking with the lifting machinery complete the design. The total cost was less than half that asked for an iron structure.

CONCRETE water pipes of small diameter, according to a foreign contemporary, are used in parts of France, notably for water mains for the towns of Coulommiers and Aix-en-Provence. The pipes were formed of concrete in the trench itself. The mold into which the concrete was stamped was sheet-iron about two yards in length. The several pipes were not specially joined to each other, the joints being set with mortar. The concrete consisted of three parts of slow-setting cement and three parts of river sand, mixed with five parts of limestone debris. The inner diameter of the pipes was nine inches; their thickness three inches. The average fall is given at one in five hundred; the lowest speed of the current at one foot nine inches per second. To facilitate the cleaning of the pipes, man-holes are constructed every one hundred yards or so, the sides of which are also made of concrete. The trenches are about five feet deep. The work was done by four men, who laid down nearly two hundred feet of pipe in a working day; the cost was about ninety-three cents per running yard. It is claimed as an advantage for the new method that the pipes adhere closely to the inequalities of the trench, and thus lie firmly on the ground. When submitted to great pressure, however, they have not proved effective, and the method, consequently, is only suitable for pipes in which there is no pressure, or only a very trifling one.

Keying in the Arch of the Garabit Viaduct.

The following description of completing the arch of the Garabit Viaduct, in France, is taken from "*Le Génie Civil*", of May 3, 1884 The arch, which has a span of 541.2ft. and rise of 170.56 ft., is hinged at the springing-line. The depth of the key is 32,8 ft. and the extrados is 383.7 ft. above the bottom of the valley.

In its construction, false-works were used, suspended from steel cables attached to the tops of the towers of the viaduct. The keying piece, in the intrados, was put into position on April 23, 1884, in the following manner: During erection the two halves of the arch had



been kept about 3½ in. above their final position, thus leaving a space between them somewhat larger than the key-piece of the lower chord, and permitting this member to be put into position without difficulty. The space of 3½ in. left after the lower chord piece was in place, was closed by slackening the anchorage cables, which was done by removing a certain number of wedges which were placed at the connection between the cables and the towers. Within three days, that is, on April 26th, the remaining part of the central panels were put in place and the arch finished. M. Boyer is the designer and engineer of the bridge, and M. Eiffel the constructor.

Concrete Buildings for Farms.

Buildings made of concrete have never received the attention in this country that they deserve. They have the merit of being durable and fire-proof, and of not being liable to be blown down by violent winds. It is very easy to erect them in places where sand and gravel are near at hand and lime is comparatively cheap. Experiments made in England show that coal screenings may be employed to good advantage in the place of sand and gravel. Mr. Samuel Preston, of Mount Carroll, Ill., has a dwelling and several other buildings made of concrete and erected by himself. They were put up in 1851, and are in excellent condition. In *The Farmers' Review* he gives the following directions for building concrete walls:

First, secure a good stone foundation, the bottom below frost, the top about one foot above ground. Near the top of the foundation bed in 2×4 scantling edgewise transversely with the walls, at such distances apart as the length of the planks that form the boxes to hold the concrete may require, the ends of the scantling to run six inches beyond the outside and inside of the wall. Now take 2×6 studding, one foot longer than the height of the concrete walls are to be, bolt in an upright position in pairs to each end of the 2×4 scantling, and, if a foot wall is to be built, sixteen inches apart, as the box plank will take up four inches. To hold the studding together at the top, take pieces of 2×6 lumber, make two mortices in each piece large enough to slip easily up and down on the studding, forming a tie. Make one mortice long enough to insert a key, so that the studding can be opened at the top when the box plank are to be raised. When the box plank are in position nail cleats with a hole in each to them on each side of the studding, and corresponding holes in the studding, into which insert a pin to hold the plank to the studding. Bore holes along up in the studding to hold the boxes when raised.

To make the walls hollow, and I would do it in a building for any purpose, use inch boards the same width of the box plank, one side planed; put the two rough sides together with shingles between, nailing them together with six-penny nails, place them in the middle of the wall, the thin end of the shingle down. That gives them a bevel and can be e sily raised with the boxes. To tie the wall together, at every third course place strips of boards a little shorter than the thickness of the wall, cut notches in each so that the concrete will fill in, holding all fast. The side walls being up, place two inch plants on top of the wall upon which to rest the upper joists, put on joist and rafters, remove the box plank, take inch board for boxes, cut to fit between joists and rafters, and fill with concrete to upper side of rafters, which makes walls that will keep out cold and damp, all kinds of vermin, and a roof which nothing but a cyclone can remove. In making door and window frames, make the jambs two inches narrower than the thickness of the walls, nailing on temporary two inch strips.

Make the mortar-bed large enough to hold the material for one course; put in unslacked quicklime in proportion to 1 to 20 or 30 of other material; throw into it plenty of water, and don't have that antediluvian idea that you can drown it; put in clean sand and gravel, broken stone, making it thin enough, so that when it is put into the boxes the thinner portion will run in, filling all interstices, forming a solid mass. A brick-trowel is necessary to work it down alongside the boxing plank, One of the best and easiest things to carry the concrete to the boxes is a railroad wheelbarrow, scooping it in with a scoop-shovel. Two courses a week is about as fast as it will be safe to lay up the walls.

The Man in the Moon.

A gentleman in the engineer's department of the Union Pacific railway kindly furnishes the following facts:

Professor Warner, of Rochester observatory, received lately from Professor Blendman, of Berlin, Germany, a communication of a most interesting nature. It related to the earth's moon. By a new photographic process views of the moon have been taken and afterward enlarged, which completely upset preconceived ideas of the state of things in the world's satellite. The flat-looking areas, formerly thought to be seas, are shown to be cultivated lands, while the rugged portions, supposed to be mountains, are in reality sand plains. Moreover, cities, villages, etc., were plainly to be seen, with living creatures moving in the streets, and unmistakable signs of industry and traffic.

On the 10th instant Professor Warner was enabled, by using the new process, to obtain well defined pictures of the full moon, from which he is led to conclude that, by employing a larger telescope than the instrument used on that occasion, the discovery of the Berlin scientist will be fully verified.

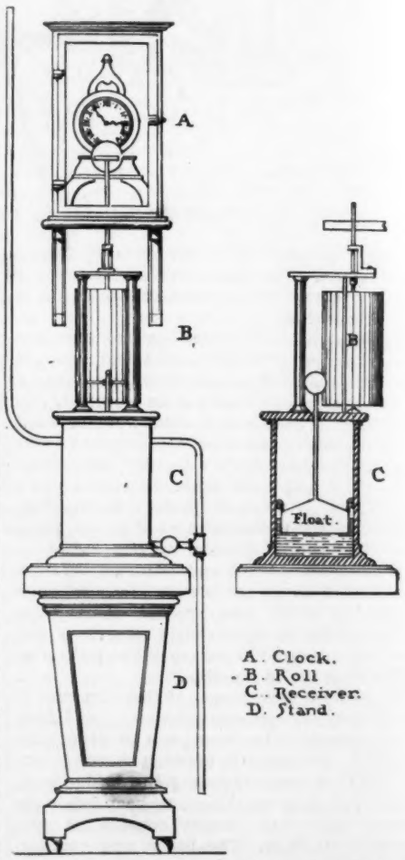
CEMENT for iron, we learn from an exchange, can be made as follows: "Two parts of well-dried powdered loam and one part of borax are kneaded, with the requisite quantity of water, to a smooth dough, which must be at once applied to the joints. After exposure to heat this cement adheres even to smooth surfaces so firmly that it can be removed only with a chisel. Another cement for steam pipes is prepared by mixing 430 parts (in weight) of white lead, 520 of powdered slate, 5 of chopped hemp, and 45 of linseed-oil. The two powders and the hemp, cut into lengths of one-quarter to five-sixteenths of an inch, are mixed, and the linseed-oil gradually added, and the mass kneaded till it has assumed a uniform consistency. The cement is said to keep better than ordinary red lead cement." It is always well to gather as much knowledge as we can along the road of life.

Maximum Rates of Rainfall.

Written for Engineering News.

BY DESMOND FITZGERALD, CIVIL ENGINEER, SUPT. W. DIV. BOSTON WATER WORKS.

THE discussion contained in this article will be limited to observations made during the past five years. In 1878 the writer was led to design a chronographic rain gauge for use at Chestnut Hill Reservoir in the city of Boston. As an outline sketch of the gauge is given herewith, it will be sufficient to explain only the general principles which were adopted in its construction. The standard gauge used by the Boston Water Works has an opening of 14.85 in., in which area 100 oz. of water makes an inch. The rain caught is weighed. Thus 33⅓ oz. equals ·335 in. of rain. One of these standand rims was set 3 ft. above the roof of a small building at a height of 25 ft. above the ground, and bracketed out from the end of the building so as to give a fair exposure. From this collector the rain descends through a glass tube to a composition receiver marked C on the cut. This receiver was most accurately bored to a diameter giving half the area of the collector on the roof, which doubles the scale for accuracy of reading.



A float, with pencil attached, makes a record on a paper, specially graduated, which is drawn tightly around a roll [B] revolved by a tower clock once in every twenty-four hours. The roll is arranged to provide for 6 in. of rain.

A section of the paper is given herewith. The vertical spaces of 2 in. between the heavy blue lines represent 1 in. of rain, while the horizontal spaces between the red lines of 1 in. represent each hour of the day. The smaller subdivisions represent tenths of an inch of

rain and quarters of an hour of time respectively. As will be seen it is possible to interpolate the minutes, say to within two or three minutes at sight, and to read the rain to within two or three hundreths of an inch without any trouble.

The principle aim was to devise an instrument which should give as little friction as possible, and this has been secured so far, that when the pencil is deflected purposely from its position it returns invariably to the point from which it started.

A graphical representation of all the rain storms occurring during the past five years has thus been secured, affording an excellent opportunity for studying some of the phenomena connected with the fall of rain. Snows have not been included on account of the difficulty of avoiding serious errors in collection by this method.

As the subject of the *maximum rate* of the fall of rain in heavy storms is one of interest to the profession, the writer has selected from the record sheets, the heaviest down-pours during the past five years, beginning Jan. 1879 and ending Jan. 1884. These rains have been grouped together on one sheet, which is here re-produced.

There are several peculiarities about these storms which strike the eye at first glance.

In the first place it will be noticed that there are no hours given after midnight; in fact the sheet has been cut off at that point. The reason is that none of the storms selected, as giving the greatest falls in the shortest time, occurred between the hours of midnight and noon. They have all come in the afternoon, and the larger proportion, as will be seen by an inspection of the diagram, fell between one and five o'clock p. m. The writer did not discover this fact until they had been collated and plotted on one sheet. This led to an investigation of the other large rain-falls during the same period, but not included in the diagram. On Oct. 22d, 1880, a drizzle began at 1.15 p. m. At 2 p. m. heavy rain fell until 11 p. m., when a drizzle succeeded until 3 a. m. Oct. 23d. The whole storm was 1.69 in., and it nearly all occurred between 2 and 11 o'clock p. m. A rain of 1.55 in. on Feb. 12th, 1881, nearly all fell between the hours of 2 and 7 p. m. On Mar. 9th, 1881, it began to drizzle at 1 p. m. increasing to heavy rain at 6 p. m., which continued until 3 a. m. Mar. 10th, at which time 2 in. had fallen. The rest of the storm, until 3 a. m. Mar. 11th, amounted to but 43 in.

The rain of May 16, 17, 18 and 19, 1881, 1.49, in., was one steady drizzle, with the exception of what fell between 2 and 4 p. m. May 16th, 9 and 12 a. m. May 17th, and 8 and 11 p. m. May 18th, and 2 and 3 p. m. May 19th. On June 10, and 11, 1881, a heavy rain, amounting to 3.83 in., fell. This was a most exceptional storm, not on account of its amount or rate but for its extraordinary regularity of profile, its very gradual increase to a maximum between the hours of 9 a. m., and 6 p. m., and its very gradual cessation on June 11th, at 1 p. m. It is regretted that space does not allow of a graphical reproduction of this storm, but a reverse railway curve, with its ends very much flattened, will describe its profile.

On March 1, 1882, showers prevailed from 3 a. m. to 3 p. m., when heavy rain set in, followed by drizzling, at 11 p. m. At 2 a. m., March 2d, rain again began, continuing until 9 a. m., when it drizzled to the end of the storm, at 2.30 p. m. Total, 1.46.

On April 27, 1882, a very uniform rain prevailed from 5.30 a. m. to 3 a. m. April 28th. Total, 1.41 in. At 7.10 a. m., May 12th, a fine drizzle set in, which continued to 2 p. m., May 14th, when it rained until 9 p. m., drizzling again until 3 a. m., May 15th, when it rained until 10 a. m., and the storm finished with a drizzle, stopping at 1.30 p. m. Total, 2.24. in.

On Sep 11, 1882, it showered from 10.30 a. m. until 2.45 p. m., when a heavy rain set in, lasting until 8 p. m. It showered again until 1 p. m., when it rained until 7 a. m.; the storm ending with a drizzle from this time until 10.45 a. m. Total, 3.00 in.

On Sept. 21, 1882, a rain of 1.13 in. fell, mostly between the hours of 1 and 5.30 p. m. The rain began at 4.55 a. m., and ended at 5.30 p. m.

On May 22, 1883, it began to rain at 6.30 a. m., and rained heavily until 10.15 a. m., when it drizzled until 9.30 p. m.; raining again until 11 p. m., and ending with a drizzle at 1.30 a. m., May 23d. Total, 2.28 in.

A rain of 1.65 in., October 23nd and 24th, began with drizzle from 9.30 p. m. to midnight, when it rained heavily till 10 a. m., October 24th, giving place to a drizzle, which lasted until 11.15 p. m.

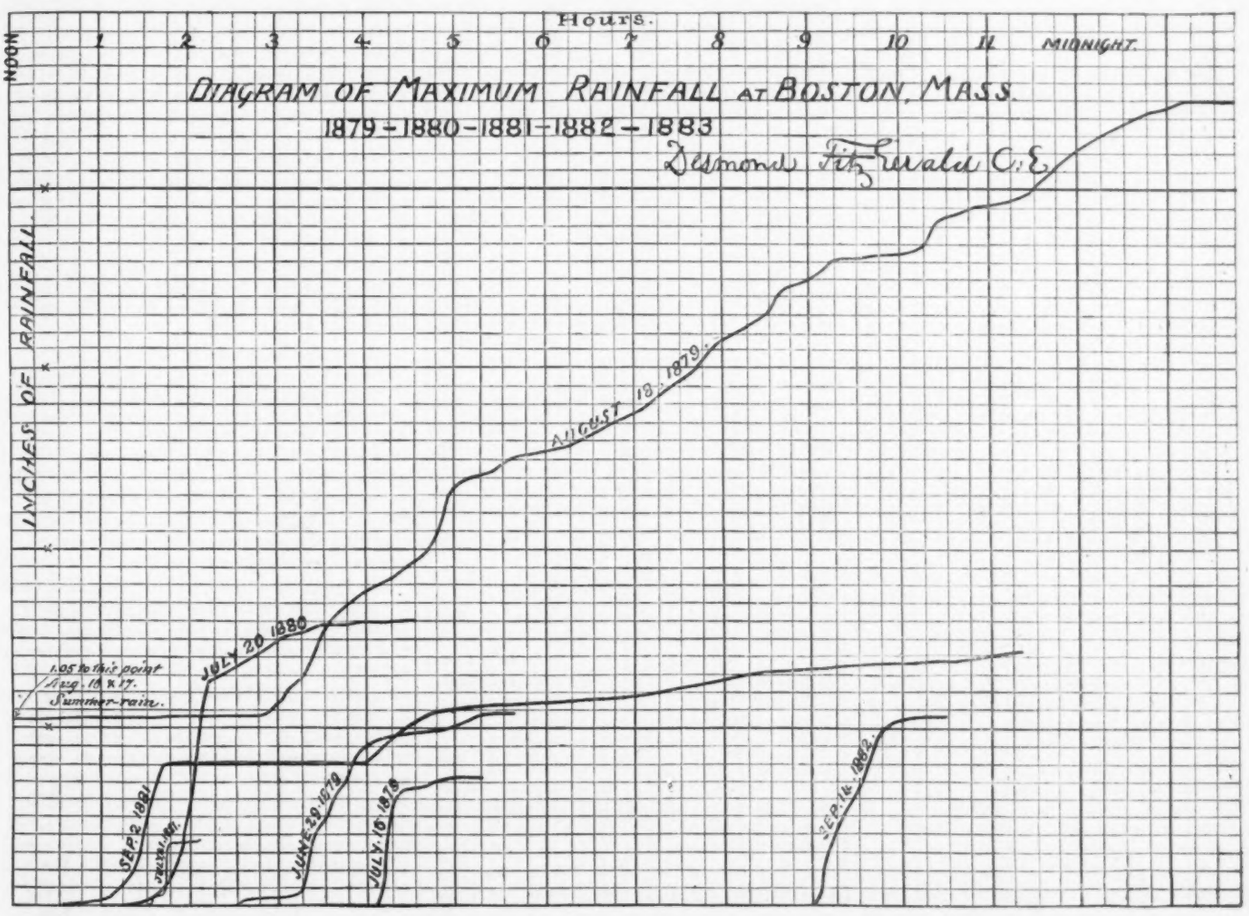
On November 26th, it showered from 5.30 p. m. until 7 p. m., when it rained heavily until the end of the storm at 2.45 a. m. March 27th. Total 1.51 in.

An examination of the record seems to show a diurnal rate in the rain fall, the periods of depression being between the hours of preceeding noon and midnight, and the periods o heavy rains occurring generally in the middle of the afternoon and then receding from 3 to 8 o'clock a. m.

The rain of August 16, 17, 18 and 19th was the most remarkable during the few years. The period of its heaviest fall, in August 18th, is given in the diagram submitted herewith.

The whole storm yielded at C. H. Res, 6.23 in. This was generally about an inch larger than was observed elsewhere in the vicinity.

A number of the storms plotted on the sheet were accompanied with hurricanes of wind, thunder and lightning, etc., and in some cases with very large hail-stones, as on July 16, 1879. It will be noticed that the greatest rates of fall resemble each other very much. Three quarters of an inch falling in thirteen minutes seem to be the maximum amount, recorded in July 20, 1880, and this whole storm yielded on the ground* 1.99 in. in fifteen hours. The storm of August, 1879, however gave more than twice this amount of



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THE funny man of a Berlin newspaper, in burlesquing American affairs, declares that an enormous hotel is soon to be built at St. Augustine, Fla. It will be three miles long, six miles deep and seventy-five stories high. Guests will be taken to their rooms by 500 balloons; the tables in the dining-room will be four miles in length, and the waiters who serve the meals will be on horseback. There will be a cuspidor in the office 100 feet in circumference. The German doesn't often try to be funny, but when he does he means business.

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* Five years observations show 10 per cent. less at a height of 25 ft.

The Behavior of Armor Under Fire.*

A valuable paper on this subject was next read by Captain C. Orde-Browne, in which he endeavored to explain the behavior of some different kinds of armor under the impact of shot, as illustrated by the most recent experiments which have been made. The natural tendency is for us to test our own shot and armor against each other, but the most important point is to know the action of our shot against the armor that our possible enemies may use. Although the former practice may appear like killing two birds with one stone, the advantage is lost if one bird prove the wrong one. The four kinds of armor referred to by Captain Orde-Browne, in the paper under notice, were wrought-iron, compound, solid steel, and chilled cast-iron. Wrought-iron yields locally, a clean hole being punched through whilst the rest of the target hardly suffers, and the entire shield is generally capable of resisting a subsequent blow as well as it resisted the first, for the shot is well supported and inclosed before the full strain comes on. Hardness and rigidity of metal in the projectile here tell to the greatest extent and tenacity to the least. These conditions have favored the use of Palliser's chilled iron shot with sharp points.

Compound armor is made by Messrs. Cammell on Wilson's patent, or by Messrs. John Brown and Co. on Ellis's patent. The steel face which constitutes about one-third the thickness of the plate is a harder class of steel than is generally supposed.[1] The shot most often breaks to pieces. The plate yields mainly by cracking in radiating lines, and sometimes concentrically.[2] Here tenacity in the shot is called for.

Solid steel as made by Messrs. Schneider and Co., for foreign ships is rather less hard than the steel face of compound armor. It admits the point of the shot at first with rather less resistance, but is less dependent on backing. As the shot enters it wedges up the metal round it, the plate swelling forward at the point of impact and yielding by radiating cracks, and not by concentric cracks. The cracks are more likely to extend through the plate than in compound armor.

The use of chilled iron armor made by Gruson has been almost entirely confined to foreign coast armor defences. It is very hard and rigid and the shock is transmitted through the whole mass, so that it must be broken up bodily to be destroyed. The author then described a number of trials of shot against armor illustrating two subjects by means of diagrams, photographs, and models. In March, 1882, Krupp pierced two 7 in. wrought-iron plates with 10 in. of wood between, with a steel 5.9 in. projectile striking directly. A similar projectile perforated 7.9 in. of iron, with 9.84 in. of wood and 0.98 in. of iron, striking obliquely at 55 deg. At Spezia, in November, 1882, steel-faced plates 19 in. thick supplied both by Messrs. Cammell and by Messrs. John Brown and Co. competed with 19 in. solid steel supplied by Messrs. Schneider. Each plate first received a blow from a chilled Gregorini iron projectile weighing 2,000 lb. fired from a 100 ton gun with sufficient velocity to perforate a wrought-iron plate of 19 in., that is, about 1,225 ft. per second. A second blow from a similar projectile was delivered on each plate with a velocity of about 1,560 ft., capable of penetrating about 25 in. of wrought-iron. About the same time a very similar trial was carried out at Ochta, near St. Petersburg, where 12. in. Cammell steel-faced plates and Schneider steel plates were attacked by an 11 in. gun firing chilled iron projectiles with the necessary velocity to perforate 16.3 in. of iron, and afterwards with the velocity necessary to go through 12 in. At Spezia the French steel plate stood best, but at Ochta the advantage was still more strongly in favor of the compound plate. It should be stated, however, that the compound plate was not properly tempered.

In 1883 a remarkable experiment on the resisting power of plates of iron and steel-faced plates fastened to granite, was carried out at Shoeburyness. The iron consisted of two 8 in. plates with 5 in. of wood between, and the steel-faced plate was 12 in. thick. The 80 ton gun was fired at these with a projectile of chilled iron weighing 1,700 lb., with a velocity of nearly 1,600 ft., capable of perforating 24 in. of wrought-iron. The shot cut through the iron, breaking up and penetrating nearly 10 ft. into the granite. Against the steel-faced Cammell plate the shot broke up, the head lodging in the plate, but not breaking or detaching it. The blow had about 30,000 foot tons energy. The author then referred to the trials of Captain Palliser, of June 6, 1882, and April 5, 1883, and Sir Joseph Whitworth's experiments of August last, when with a 9 in. gun, 29 calibres long, a forged steel shell weighing 403 lb. was driven through 18 in. of wrought-iron plate, with a striking velocity of about 1,900 ft. At Buckau Magdeburg in October, 1883,[3] a chilled iron shield with a maximum thickness of 47½ in. was attacked by a 12 in. (30.5 c.m. Krupp gun firing a steel projectile weighing about 980 lb., with a striking velocity of 1,460 ft., and having an energy, therefore, of about 14,500 foot tons. After three rounds the shield was cracked across in more than one direction, and a fourth shot began the actual displacement of the fragments. The author referred to the uselessness of the plan usually followed of comparing the efficiency of a shot when fired against a steel plate, on the basis of the striking energy sufficient to perforate wrought-iron of the same, or 20 per cent. greater thickness. Some experiments were performed at the meeting by dropping weights representing ogival shot of different sizes, steel and wrought-iron being represented by flat bricks and millboard respectively. It was suggested that experiments might be made by firing steel bullets against plates of steel and chilled iron. Sir Joseph Whitworth had been understood to say that experiments with bullets represent generally the conditions of similars trials with ordnance. The author concluded by saying that last year a commission was sent over from America to investigate the condition of iron and steel in Europe, and the report spoke very unfavorably of English steel. This was to be understood if it referred to our steel projectiles, which seem especially to need improvement at the present time.

Captain MacKinley opened the discussion on this paper by referring to the experiment that had been described, in which a plate solidly backed with granite did not give way. He considered that more attention ought to be paid to the backing of the targets used. He also referred to the influence of the size of plates in withstanding shot, and to the fact with an armor comparatively easily pierced, the turrets of a war vessel would revolve after having been struck a heavy blow, but it was questionable whether such would be the case if the more resisting compound armor were used in which the impact would be widely dispersed. He pointed out that practically there were only two makers of armor plates in this country, and thought that as a matter of national safety other firms should be encouraged to take up this industry.

Mr. James Riley animadverted on the conduct of the Goverment in not giving more encouragement to steel makers in supplying steel projectiles for experimental purposes. In France they were wiser and the Government pursued quite a different policy in this respect.

Mr. Scattergood questioned how many steel-makers understood the equations by which the paper was enriched, and he did not know how many of those versed in the mysteries of these equations were acquainted with practical steel-making; but there was one thing they could all understand, and that was the very plain statement of fact with which the author concluded his paper. In view of the condemnation that had been pronounced on English steel by the American Commission referred to, he thought it high time the steel-makers bestirred themselves and turned out better steel. This remark at once called the President to his feet, and caused him to protest vigorously against the inference to be drawn from Mr. Scattergood's remarks. The steel referred to may have been unsuited to the purpose to which it was applied, but it need not have been bad steel. It was the duty of the experimentalists to say what kind of steel was wanted, and if they would do their duty in this respect the steelmakers of England would do theirs and supply such steel. This he considered it his duty to say at once, whether the discussion went further or not.

Mr. Nordenfelt bore testimony to the want of encouragement the manufacturers of steel received from our Government, which was an unfortunate contrast to the more enlightened policy of the French authorities. In this country the engineering officers were tired of begging for money for purposes of experiment, so unfavorably were their suggestions received; and they were debarred from asking manufacturers for specimens as they had no means of testing them.

The President closed the discussion, repeating his former statement that English manufacturers only required to know what was expected of them in order to do what was required.

Captain Orde-Browne replied to the discussion in a long and interesting speech. He referred at length to some experiments made by Krupp, who wished to prove that his wrought-iron shield was better than one made on the Gruson principle. He had decided to use chilled shot in these experiments, but found his rival's shield to stand so very well against that description of projectile, that he was compelled to alter his programme and use steel shot for the purpose of destroying the Gruson target. Captain Browne quoted these facts in order to illustrate the necessity of making experiments of this nature under wider conditions than are usual in England. When a hard shot is fired at soft armor the shot penetrates and then breaks up, but the point remains intact, and the projectile is supported in the hole it makes, so that further penetration is effected. When firing at hard armor with soft shot the point penetrates a short distance, and at the same time sets up. This has the effect of opening the cracks made in the armor. He referred to the well-known fact that a steel plate faced with wrought-iron will be more easily penetrated than if the iron were absent. This was because the iron being easily entered formed a support for the shot and prevented it from breaking up on the face of the steel. The speaker then referred briefly to the properties of double armor, that is, two skins with a space between, but as he remarked, the subject is such a wide one that it would require separate treatment to do it any thing like justice. In reference to the remark of Mr. Scattergood, and those that had been called forth by it, Captain Orde-Browne in the first

* Read before the Iron&Steel Institute, London, April 30.

[1] At Spezia, in 1882, the steel face of Brown's and Cammell's plates, contained respectively 0.5 and 0.7 per cent., and Schneider's solid steel plate of about 0.45 per cent. of carbon.

[2] Major O'Callagan, R. A., has contributed a valuable paper to the R. A. Institution on these points.

[3] For details of experiments with Gruson's cast-iron armor, see ENGINEERING NEWS, page 213 and 255.

place asked not to be considered responsible for all conclusions that might be drawn by American commissioners. In the instance referred to the use of steel as applied to steel projectiles only had been considered. He dwelt at some length on this point, and spoke strongly on the duty of the Government towards the country in these matters. From the tenor of his remarks it was evident that he considered such blame as there might be, rested with the Government authorities and not with the steel manufacturers, a point worthy of note, as coming from one in Captain Orde-Browne's position, and who certainly would not be unduly biassed towards the steel makers.

New York Building Notes.

THE St. Nicholas Hotel, of New York, famous in years gone by for its elegant appointments, and unrivalled cuisine, is demolished. About the middle of June the foundation for the new building to take the place of the hotel will be laid. It will be used for business purposes. The front will be of brick and stone, with terra cotta trimmings. The building will be 100 ft. wide on Broadway and 140 ft. on Mercer street. It is expected that the building will be completed by May, 1885.

BUILDING operations in New York are already on a scale equalling that of last year; since Jan. 1 to the end of last week (May 24) plans for 1,284 buildings have been filed; estimated cost $23,000,000.

MR. José F. NAVARRO has filed plans for ten twelve-story apartment houses to cost $1,000,000, and to accommodate 228 families.

AT Nos. 24, 26 and 28 Broadway, the Standard Oil Company propose to erect a nine-story office building of brick, stone and iron, with brick and slate roof, to cost $450,000.

AT Nos. 3 and 5 East Twenty-eighth Street the Paran Stevens estate will erect a ten-story flat of brick and iron, with a brick roof, to cost $150,000.

BUT the most towering structure of all is the Navarro flats, on Seventh Avenue, between Fifty-eighth and Fifty-ninth Streets, with a frontage of 425 ft. on the streets and 200 on Seventh Avenue. The building is nearly completed, and has been erected at a cost of $5,000,000. On the streets it is nine stories in height, with basement, and fourteen stories in the centre. The courts cross each other at right angles, and these, with other arches, divide the whole structure into eight houses.

THE large number of ten and twelve-story apartment houses raises the interesting question as to their security in case of fire. To obtain an expression of opinion on this point a reporter called on Inspector Esterbrook to whom that official expressed himself with great frankness and vigor:

"We cannot," he said, "make laws, and must go to court to enforce those already enacted. Our power is very limited, and everything we do is resisted to the last extremity. One hotel man fought me a year and a half about putting up fire escapes. I have a list here of the men who went to Albany to get a law passed placing this Bureau under the control of an irresponsible board of six persons. Looking over this list I see I have had one half of them under the harrow for violation of the law. One of these men came to me the other day and said, 'Why do you ask us to go to so much expense, merely perhaps to save a dozen lives a year? But we shall keep asking this expense in order to save life as long we are here. I think there is a little desire to erect better buildings on the part of some, but others are as bad as ever; just as some will run all risks to cheat, while others are afraid to hold back. The great bulk of apartment houses in the city I consider exceedingly dangerous. There are scores of hotels and flats that I would not sleep in over night as long as I could stay in the street. I recall one hotel in particular, in which a fire could not but result in great loss of life. The law should require that all apartment houses and hotels should be absolutely fireproof, or if not, limit their height and secure safety by requiring the most ample means of exit from every part in case of fire. But there is no such law at present, so we can do nothing in that regard. The city ordinance is of course inoperative."

THE Third Avenue Horse Railroad Company is about to build a one-story stable, 200 ft. sq., on Tenth Avenue, between 128th and 129th Streets, at a cost of $200,000.

A Topographical Survey of Massachusetts.

The Committee on Finance has reported a resolve providing that the Governor, with the advice and consent of the Council, may appoint a commission, consisting of three citizens of the Commonwealth, qualified by education and experience in topographical science, to confer with the director or representatives of the United States Geological Survey, and to accept its co-operation with this State in the preparation and completion of a contour topographical survey and map of this Commonwealth. These Commissioners are to serve without pay, and they are to have power to arrange with the Director or representative of the United States Geological Survey concerning this survey and map, its scale, method of execution, form and all details of the work, and may accept or reject the plans of the work presented by the United States Geological Survey. They may expend in the prosecution of this work a sum equal to that which shall be expended therein by the United States Geological Survey, but not exceeding ten thousand dollars during the year ending June 1st, 1885, and not to exceed the sum of fifteen thousand dollars in any one year thereafter, and the total cost to the State of the survey shall not exceed forty thousand dollars.

In presenting this resolve the committee states: The United States Geological Survey, under the direction of Major J. W. Powell, has entered upon a Geological Survey of New England, beginning with this Commonwealth, with a view of preparing, on a small scale, a geological map of the same. The Director of the United States Geological Survey has offered to co-operate with this Commonwealth in a more elaborate survey and the preparation of a more perfect map of this State on a larger scale, and with contour lines, showing the topography with much accuracy and detail. He estimates that the necessary surveys and office work can be done within a period of three, or at most four years, and at a total expense not exceeding eighty thousand dollars, and offers that the United States Geological Survey will bear one-half the expense of the office and field work, togther with all the expense of engraving the map, the engraved plates of which may be used by the State for the purpose of making transfers therefrom. From the testimony of gentlemen of the highest authority in scientific matters of this nature, and the position and progress of other States also, the committee are convinced that in this respect Massachusetts is far below the position which her people desire she should sustain as an enlightened State, and that many and great advantages will result to her citizens from the successful completion of this enterprise. The map resulting from the work now proposed will give us, beside the trigonometrical survey, accurate indication of water courses and water shed, lakes or ponds and their height above sea level, roads, villages and towns, together with contour lines indicating the relative and actual hight above the sea of the localities where they run, and perhaps some other details. If advantage is taken of this opportunity the people of the State will secure a map of unquestioned accuracy and superiority in the details of its topography for the comparatively small sum of forty thousand dollars, possibly even less.

THE *North American Review* for June opens with an article on "Harboring Conspiracy," by Prof. Henry Wade Rogers, who examines, in the light of international law, the diplomatic history of the United States and the national constitution, the question as to how far our goverment may and must go in suppressing plots against governments with which we are at peace. Henry D. Lloyd, in the same number of the Review, shows how every branch of production is coming under the control of "Lords of Industry," corporations and monopolies. Elizbeth Stuart Phelps has an article marked by rare philosophic force upon the "Struggles for Immorality." Other articles of not less importance are: "Sociological Fallacies," by Prof. W. G. Summer; "The Rise and Fall of Authority," by President J. C. Welling; "Walt Whitman," by Walker Kennedy; and a symposium on "Expert Testimony," by Rossiter Johnson, Dr. W. W. Godding, T. O'Conór Sloane and Dr. Charles L. Dana.

SELECTED MISCELLANY.

MINNESOTA has no less than 7,000 lakes, which take up over 2,700,000 acres of territory.

THE longest single line of pneumatic tubes in successful operation runs between the London, England, Central Telegraph office and the House of Commons, a distance of two and three-fifth miles.

THE survey of the Jordan Valley has established the fact that the English canal project is impracticable. It was found that cuttings would have to be made for fifty miles through a plateau from 600 to 800 feet above the Mediterranean, and no one, unless perhaps De Lesseps, would think of undertaking such a thing.

THE total permanent railroad investments and assets of the United States amount to $5,658,914,158. Of this the aggregate funded debt is $2,390,915,401. The number of persons owning an interest in our railroads is 300,000. These are all bloated capitalists and aristocrats, according to the anti-monopoly theory, and have few rights which Legislatures should respect.

JAPAN has at present 155 miles of railroad—from Yokohama to Tokio, 18 miles; Kobe to Otsu, 58 miles; Tsongara, in the Province of Oomi, to Sekigahara, in the Province of Mino, 41 miles, and Tokio to Koumagai, 38 miles. There is besides in course of construction a road to unite Maye-bashi to Tokio, a distance of 81 miles.

THE visits to the Paris sewers have begun anew. Entrance can be obtained only by special permits from the Prefect of the Seine. Four trips a day are made from the Châtelet to the Madeleine, and *vice-versa*, 88 persons only being admitted at a time, thus making a maximum of 352 visitors a day. The average number of applications for tickets every year is 35,000, out of which only 4,500 can be granted.

A PAVEMENT of earthern-tile blocks, about eight inches square and four inches thick, impregnated with bituminous products and laid with hot-tar joints on six inches of concrete, has been put down experimentally in Berlin. It is not expected to be subjected to the American process of tearing up every few months to lay down a new line of pipes in the street and to be relaid by a contractor who is not responsible to anybody.

A RETURN relating to the tramway system in France gives the total length of lines at about 332 miles The department containing the longest mileage is, of course, that of the Seine, which includes Paris. Here the length is about 120 miles. Besides Paris, the towns which have tramways running are Lyons, Marseilles, Harve, Rouen, Beziers, Tours, Nantes, Orleans, Rheims, Nancy, Cambrai, Dunkirk, Lille, Roubaix, Tourcoing, Valenciennes, Bologne-sur-Mer, Calais and Versailles. The total receipts for all the lines during 1883 were about $7,130,000.

AN interesting illustration of the uncertainties of well-boring operations has just occurred at Burton-on-Trent, England. One of the largest breweries there had occasion to increase its water supply. Recourse was had to boring, and the work was carried out by a local well sinker. The spot chosen proved an unfortunate one, and after a depth of 176 feet had been eached, Messrs. Le Grand & Sutcliff, artesian well engineers of London, were consulted as to further search for water. This firm, having had considerable experience in well-making operations at Burton, advised the abandonment of the boring and suggested a fresh site which they selected. This suggestion was adopted, and at a depth of only 114 feet a supply of between 5,000 and 6,000 gallons per hour has been obtained from a single five-inch tube well. It should be mentioned that the level of the two sites was practically identical, and the distance between them about two hundred yards.

LAST year there were 921 separate fatal accidents in English coal mines, as against 876 in the year 1882. The total loss of life is reported as 1,054 for the year and 1,126 for the previous year. There were twenty-five explosions of fire damp, with a loss of 134 lives as against thirty-five, with a loss of 250 lives in the previous year. But more lives were lost in consequence of falls of roof and sides in the mines—469 last year, against 468 in the preceding year. The loss of life in the shafts of the mine was less—97 against 116; but the lives lost from explosions of powder, by machinery under ground and other causes in the mine rose from 208 for the year 1882 to 246 for the past year. The loss of life at the mines on the surface was also greater, the increase being due in part to a greater loss from machinery, the total loss of life on the surface being 108 instead of 84, as in the year 1882. There is, therefore, a considerable reduction in the loss of life from great mining accidents, but the loss from smaller and single accidents shows a slight increase on that of the previous year. The number of persons employed in and at the mines was, however, considerably increased during the year, the total being 10,000 more than in the year before, and thus, while in the year 1882 there was one death by accident for every 447 persons employed, last year there were 488 persons employed for every such death.

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WE want Nos. 2 and 3 of present volume of ENGINEERING NEWS, for which we will extend any subscription one month for each paper sent.

THIRTEEN thousand immigrants were landed at Castle Garden, last week. This number represents the population of a good-sized city with all that the term implies.

THE last meeting of the American Society of Civil Engineers before the summer vacation, will be held on Wednesday evening next. It will no doubt be a well attended meeting as the final arrangements for the Convention will be announced; there will be many prominent out-of-town engineers present who intend to go to the Convention, and there will be the usual excellent collation served after the reading and discussion of papers. Every member who can attend should endeavor to be present.

BALDWIN LATHAM'S *Sanitary Engineering* is selling far beyond our most sanguine expectations, considering how many copies we have previously placed with the profession. Aside from the demand by new subscribers, we are selling the book to plumbers, sewer-builders, health officers, and to some people who would not usually be considered as interested parties. Book dealers also are sending in more frequent orders as the edition becomes more widely known.

We must correct an error into which some parties have fallen. We *do not* give a copy of *Sanitary Engineering* to any person who will subscribe for ENGINEERING NEWS; we *do* offer a free copy of *Sanitary Engineering* to any *present* subscriber to ENGINEERING NEWS for his trouble in securing us one more subscription. Both book and paper are well worth the prices asked for them, and we have no idea of paying any person $2 to subscribe for our $4 journal. But we are always obliged for a "friendly turn," and as far as we are able, wish to reciprocate in a substantial way.

We are much obliged for the favor of excursion tickets over the Wabash, St. Louis and Pacific Railway, from St. Louis to Columbia, Mo., and return, sent us by Professor Thomas J. Lowry, the enterprising Secretary of the Missouri Association of Surveyors and Civil Engineers, as a pleasant hint to attend the meetings of the Association, to be held at the latter place June 3rd to June 9th. We have no doubt that the Convention will be a very agreeable and profitable one, if the published proceedings of the meetings of 1883 is an index thereof, and if we were a thousand miles nearer by we would be delighted to attend.

WE have been asked if the meetings of the American Society of Civil Engineers at the Annual Conventions are open to Engineers and Surveyors not members. In reply we assure our correspondents that these meetings for the reading and discussion of papers are free to all who wish to come, and it is especially desirable that Engineers avail themselves of the opportunity of seeing some of the advantages of association with their professional brethren. Excursions and entertainments are matters of local courtesy and control, and to participate in them it is necessary to obtain invitations from the local committee. The Society itself is a guest of the always generous citizens of the city visited.

THE opposition against the proposed Manchester (England) Ship Canal, increases in its bitterness as it grows. New forces are continually being brought to bear against the proposed scheme by the authorities and commercial magnates of Liverpool.

During the last two weeks, the Committees on the Canal Bill have been occupied in hearing further testimony, against the project, from the Mersey Docks and Harbor Board, the Shropshire Union Canal Co., and the London and Northwestern Railway Company. All of these corporations unite in testifying that, if the canal should be built, the channel at Liverpool would be injuriously affected, and vast outlay for public works rendered useless; they also attack the estimates of cost of the proposed canal, as likely to fall far below the actual outlay for constructions.

This opposition, while undoubtedly well founded in some of its physical and engineering features, is scarcely to be wondered at. Liverpool has long been the supreme commercial metropolis of England, and, in caring for the world's commerce, has expended vast sums in its magnificent docks and warehouses. It naturally objects to any scheme which has for its main object the diversion of a large part of this traffic. And that ships, loaded with Manchester goods, at Manchester, should sail past its docks without paying tribute to the lords of trade of Liverpool, is especially aggravating.

First Anniversary of the East River Bridge.

On May 24, 1883, one year ago last Saturday, the East River Bridge was first opened to public traffic, with becoming ceremonies. The only outward signs of the return of this day, famous in the annals of bridge-building, was in the national flag hoisted upon the two towers, and in the donning of new helmets by the bridge policemen.

The total financial outcome of this first year's business was $390,040, divided as follows: from 6,083,100 foot-passengers, $60,891; from 587,024 vehicles of all kinds, $73,378; and from 5,151,220 car passengers, $257,561.

JOS. P. COTTON, M. Am. Soc. C. E., Commissioner and Chief Engineer of the Seekonk River Bridge, Providence, R. I., was in New York on Wednesday, on business connected with the above enterprise.

PERSONAL.

A. G. PUGH, Superintendent of Sewers, has been appointed Assistant City Civil Engineer of Columbus, O., at a salary of $1,200 per year.

PUBLICATIONS, communications, etc., intended for the *American Institute of Mining Engineers* (heretofore sent to Dr. T. M. DROWN, Secretary, Easton, Pennsylvania) should be sent hereafter to R. W. RAYMOND, *Secretary*, by mail, to box 223, New York City; or by express or messenger, to 13 Burling Slip, New York City.

MINNEAPOLIS, Minn., May 23.—A special from Bozeman, Montana, says: JOSEPH WORLEY, a Civil Engineer, formerly of St. Paul, who has lately been in the employ of the Northern Pacific Railroad Company, shot himself through the heart at the gate of the Masonic Cemetery to-day. He was found dead, with a pistol in his hand and a cigarette held tightly between his teeth.

ROBERT FLETCHER, Professor of Civil Engineering, Dartmouth College, Hanover, N. H., is spending the week in New York city and vicinity, visiting all the engineering works of interest. PROF. FLETCHER will go to Philadelphia early next week, returning in time for the special train of the American Society of Civil Engineers to the Buffalo Convention.

MR. KEENE was a Stock Exchange gambler pure and simple. He bought and sold stocks, corn, whiskey, and everything else likely to go up and down in the market, much as a speculator does here, except that his operations were on a larger scale than that to which we are accustomed. He used, it is said, to write memoranda of his transactions on the cuffs of his shirts, and his washer-woman made a fortune by showing these notes to smaller speculators.—*London Truth.*

MR. GRAHAM SMITH, C. E., Past President of the Liverpool Engineering Society, and a well known writer on civil and mechanical engineering subjects, recently Engineer to the Port of Rangoon, India, arrived in this city by the *Republic* of the White Star Line, on the 24th. MR. SMITH is going as far west as the Pacific Coast, and expects to return to New York inside of two months. He is travelling on the business of Messrs. Fowler & Baker, Engineers of the New Forth Bridge, Scotland.

COL. JOSEPH FISK died in the early part of last week at Allegan, Mich., aged 74. He had been identified with a number of important railroad enterprises during his long and busy life. He was born in Charlemont, Mass. His father removed when he was a boy to Macedon, N. Y., and afterward to Willamson, Wayne County, N. Y. In 1834 JOSEPH FISK went to Michigan and settled in Allegan, then a mere hamlet. For some years he was quite extensively engaged in building operations. In 1832 he took a contract for building the Chicago breakwater, and his successful performance of that job gave him prominence as a contractor. In the following year he took contracts for building the Eel River Railroad in Indiana, about 100 miles in length. In 1854-5 he was connected with the Dubuque and Pacific Railroad in Iowa, and from 1857 to 1863 was in Missouri.

Immediately after the war COL. FISK returned to Missouri and re-engaged in railroad work. From 1867 to 1871 he was engaged in pushing several railroad extensions in the western part of Michigan. His last contract of any note was with the Lake Shore and Michigan Southern Railroad. In all he built over 1,000 miles of railway, and in his various transactions he showed admirable business qualifications, which, with sterling honesty, secured for him the confidence and respect of all who knew him. He had been out of active business for several years.

Engineers' Club of Philadelphia.

RECORD OF SPECIAL BUSINESS MEETING MAY 17TH.

Vice-president J. J. deKinder in the chair; 28 members and 4 visitors present.

The Secretary presented, for Mr. Edward Parrish, an illustrated account of the Effect of Sea Water on the Iron of Brandywine Shoal Lighthouse. This Lighthouse was built in 1849-50, near the mouth of the Delaware Bay, and stands in about 6 feet of water. It is the first screw-pile structure built in the United States, and has but few predecessors in the world. The house is supported on nine piles of hammered iron, surrounded by fifty-two piles of rolled iron, acting as an ice fender. The whole is strengthened by systems of braces and ties. The effect of the water on the iron, continually submerged, has been to produce longitudinal seams or grooves, with occasional holes on the surface; in some cases seriously reducing the strength. The most extensive corrosion is observed on the hammered iron. Round rods in the air are altered in section approximating an irregular polygon with longitudinal grooves.

The Secretary presented, for Mr. Sam'l Rea, "A Treatise on Bridge Architecture in which the Superior Advantages of the Flying Pendent Lever Bridge are Fully Proved," by Thomas Pope, New York, 1811, with Mr. Rea's comments thereupon.

Prof. L. M. Haupt read an illustrated paper on Rapid Transit, giving valuable data relative to the effects of velocity of movement on the ratio of increase of population and contrasting the situation in New York and Philadelphia. In comparing the topography of the two cities, a silhouette of Manhattan Island was laid on a map of Philadelphia (same scale), showing that the island from the Battery to 150th Street, (nine and a half miles), only extended from League Island to Erie Ave. From this it was inferred that, if there was need for elevated roads in New York, there was greater need for them in Philadelphia "*as the necessity is proportional to the extent of surface of a city and the distance of its residents from the business centres.*" The former commercial supremacy of Philadelphia was considered, with the reasons for the rapid decline in the ratio of increase of population, which has diminished from 79 per cent. in the decade 1840-50 to 25 per cent. for 1870-80, while Camden's population has increased from 51 per cent. in 1850-60 to 108 per cent. in 1870-80. In short, Philadelphia is overflowing because her time limits of travel are too restricted. Assuming the time limits at 30 minutes each way or one hour per day, at the usual velocities of travel, the limit of the

"Pedestrian City" were found to be a square with diagonals of 4 miles and area 8 square miles.

"Horse Car or Cable City," found to be a square with diagonals of 6 miles and area 18 square miles.

"Elevated R. R. City," found to be a square with diagonals of 12 miles and area 72 square miles.

"Underground City," were found to be a square with diagonals of 20 miles and area 200 square miles.

The total area of Philadelphia is 129 square miles, and of the built up portion 13½, or 10½ per cent. Deducting from the square representing the "street car city," the salient intercepted by the Delaware River, it leaves just the same area, or 13½ square miles, showing the city to have reached the limit of street car travel. The areas benefitted vary as the squares of the velocity of travel; hence elevated roads would be worth to the city four times as much as surface lines, and underground roads about eleven times as much. Since 1850 Philadelphia has lost in population about one-half a million people equivalent to a revenue on the real estate which they would have occupied and improved of about $2,000,000 per annum. The two broad zones of the overcrowded portion of the city were also outlined, and the extent of the benefits to be conferred by only two lines of elevated roads were clearly shown by diagrams to extend to the entire city. Elevated roads occupy an intermediate position in cost of construction, rate of travel and general utility between surface and underground structure, and there can be no doubt that the time has fully arrived when this city, *for her own sake*, requires them and should heartily co-operate with any parties so proposing to improve and extend her resources. The following were some of the conclusions arrived at:

1. The city has reached and already surpassed the ordinary limits of street car travel.
2. The ratio of increase of population is rapidly declining chiefly from lack of more rapid and cheaper means of transit.
3. The present steam roads in the city cannot supply the demand as they are SURFACE line trains and must move slowly and cannot be run at close intervals; fares are too high and stations too distant.
4. Camden, N. J., is rapidly gaining population at the expense of Philadelphia.
5. The annual loss to the city in revenue from this cause will reach millions of dollars.
6. Unless relief is afforded the city will be corralled by time limits and the density of the population must increase rapidly at the expense of health and morality.
7. Two lines of elevated railroads at right angles to each other, and properly located, would benefit an area equal to double that of the built up portion of the city.
8. The fears of opponents of elevated roads of losses to the city or the individual, from withdrawal of patronage or depreciation of property, are shown by experience in New York to be groundless.
9. If Philadelphia desires to retain even the present low rate of increase in population, and high rate of salubrity, she must promptly respond favorably to the request of her citizens to be permitted to build elevated roads.
10. The limits of the city are not such as to warrant any corporation in building an underground road were it recommended or allowed, with any fair prospect of returns, for many years.

Mr. Wm. H. Ridgway read a paper upon the Action of Water in the Modern Turbine, claiming that it is nothing more than an improved Barker's Mill, and that there is no such thing as the water spurting through the shutes and impinging on the buckets as is generally believed—the wheel on the contrary taking a velocity very much greater than that of the inflowing water.

Mr. J. J. deKinder presented an illustrated description of a method of Removing Condemned Machinery by Dynamite, as practiced by him in the case of the side levers of the old Cornish Pumping Engine at Spring Garden Water Works, Philadelphia, which weighed 29,000 lbs. each. Drilling, tapping and breaking each beam in two, with half a pound of dynamite, and without injury to the building or other machinery, occupied thirteen hours. Even had dispatch been unnecessary, it might have taken two weeks to do this work by the ordinary methods.

The following contribution to the Club Reference Book were submitted:

"Tables of Turnouts from Tangents and Inside of Curves," by Theodore Low, C. E., Correspondent; "Tables of Approximate Numbers to Facilitate Multiplication and Division," by Mr. Frederic Graff; "Some Properties of Numbers," by Mr. W. G. Nelson; "Spring of Rails in Inches; Chord 10 ft. Long." by Mr. Edw. Samuel; "Table of Wheel Bases for Turntables," by Mr. Edw. Samuel.

The following gentleman were elected Active Members of the Club:

John H. Converse, W. Henry Sayen, I. Norris DeHaven, Alter Megear, Benj. P. Howell, T. A. M. Matsdaira, R. W. Davenport, John N. Pott, J. B. Wilson, Walter C. Brooke, W. Brooks Cabot, Gaylor Thompson, Wm. P. Henszey and Archibald Stevenson.

ENGINEERING NEWS: Three months for One Dollar.

Additional List of Papers to be Presented at the Buffalo Convention.

TITLE OF PAPER.	AUTHOR.
Landing Arrangements for Car Ferry on the Mississippi Riv.	ROBT. MOORE.
Analysis of the Rainfall at Lake Cochituate, Mass.	DESMOND FITZGERALD.
Timber Lands of the Northwest and of British Columbia	H. C. PUTNAM.
The Memphis Sewers after Four Years' Use	GEORGE E. WARING, JR.

Seekonk River Bridge.

Alex. McGaw, Contractor, who is now building the concrete portion of the pedestal of the Bartholdi statue on Bedloe's Island, in New York Harbor, has been awarded the masonry, etc., of the Seekonk River Bridge, at Providence, R. I., for $34,268½. Other bidders and prices were:

Ingerson and Tank, Providence, R. I.	$35,602½
Parker and Sylvester, Boston, Mass.	35,383
Boynton Bros., Providence, R.I.	36,240½
N. B. Horton, Providence, R. I.	36,934
Charles H. Edwards Providence, R. I.	37,282
Garvey Bros., Providence, R. I.	38,085½
Kenneth McKay, Attleboro, Mass.	39,127½
Edward A. Foster & Co., Pawtucket, R. I.	40,367½
Joseph Ross, Ipswich, Mass.	40,592½
Providence Pile and Bridge Building Co., Providence, R. I.	41,528½

The Seekonk River Bridge is being built by a commission of five appointed by the Governor of Rhode Island. Mr. Joseph P. Cotton, M. Am. Soc. C.E., of Newport, is Chief Engineer of the Commission. Theodore Cooper, M. Am. Soc. C.E., 35 Broadway, New York, is Consulting Engineer.

The New York Produce Exchange.

The dimensions of this great building, are as follows: Length on Broadway and Whitehall Street, 307½ ft; on Beaver Street, 150 ft.; and on Stone Street, 149 ft.; the tower being 40 by 70 ft., and 200 ft. high. The aggregate floor surface in the building is 7½ acres, and the Board Room proper is 220 by 140 ft. 60 ft. high in the center, and lighted by 23 windows, each 31 ft. high, and a skylight over the center. The cost of the site and the pile foundations was $1,000,000, and the total cost of building and site about $3,000,000.

In this great building, by the aid of the cable, the telegraph, and the telephone, the principal commercial emporium of two continents are brought into instantaneous commercial intercourse. Substantially all the agricultural productions exported from New York are bought and sold on the floor of the Exchange, and how large this business is may be estimated from the fact that in 1880 there was received at New York 59,000,000 bushels of wheat, 61,000,000 bushels of corn, and 5,000,000 barrels of flour; and in addition to these articles the transactions in beef and pork; and their related products are always on an immense scale.

THE administration of public works in Paris France, has published a report of its expenditure for the ten years between 1872 and 1881, the total being £26,160,000, of which £15,920,000 has been for new works and the remainder for maintenance and repairs. Out of the £15,920,000 spent upon new works, £9,200,000 was for making new streets and other public roads, £1,880,000 for water and sewers, £120,000 for lighting, £280,000 for public gardens, and £4,400,000 for public buildings. Out of the £10,240,000 spent upon repairs and maintenance, £5,560,000 was for keeping the roads and pavements in order, £3,120,000 for lighting, £800,000 for public buildings £320,000 for water and sewers, and £120,000 for the public gardens. The total length of the streets opened or widened since 1872 is about sixteen miles.

DURING the year ending June 30, 1883, the total number of passengers carried was 295,721,171; the gross receipts for that time were $11,000,000, and the gross expenses $8,762,000.

LITERATURE.

Transactions and Proceedings of the American Society of Civil Engineers. February, 1884.

Contents: Water-power with High Pressures and Wrought-Iron Pipe, by Hamilton Smith, Jr., and discussion. Structural Steel by Edward B. Dorsey, and discussion.

The paper of Mr. Smith relates to the conveyance of water, under high pressures, for supplying the placer mines of California, and the form of wheel used in utilizing this power. The Barker re-action wheel at first employed, was rejected for its waste of water and the turbine wheels wore out rapidly from the velocity due to the high heads.

The wheel now in general use is the so-called "Hurdy-gurdy", which has been improved until it gives an astonishingly high percentage of useful effect. The latest and most efficient form is the Pelton wheel, which may be described as a narrow wheel, built upon a cast-iron spider, keyed to the wheel-shaft, and carrying upon its face a series of buckets. The water-jet strikes this wheel tangentially, and the chief novelty in the Pelton wheel is the splitting of this jet as it strikes the wheel; an effect due to the shape of the bucket, which in section is made up of two semi-circles.

According to late experiments, a Pelton wheel, 15⅞ in. in diameter, with a jet from a ⅜ in. nozzle, and 50.2 ft. head, gave a maximum efficiency on the wheel shaft of 82½ per cent. With the same nozzle, and a head of only 8 ft. a useful effect of 73 per cent. was obtained.

The author describes the method of conveying water by wrought-iron riveted pipe, and the manner of utilizing this power, in pumping, hoisting and drilling with the diamond-drill. In augmenting its water supply the North Bloomfield Gravel Mining Co., was compelled to cross a cañon, by a pipe-line subjected to a maximum vertical head of 760 ft. The length of pipe was 4,438 ft. and the mean diameter 17 in. The pipe was made in 20 ft. lengths, double riveted, and the iron ranged in thickness from .083 in. to .165 in.; for pressures not exceeding 380 ft. head, the joints were put together stove-pipe fashion; for greater pressures, an inner sleeve was used, riveted on one end of the joint, and an outer lap-welded band over the pipe, with lead run between and caulked. No man-holes or escape gates were used. The air-valves were simply heavy flap-valves of cast-iron, on top of pipe; these valves are weighted with lead, and drop when the pipe is only partly filled and permit the escape of air; when the pipe is full the resulting pressure closes them.

The pipe was laid in 1878, and cost, for 4000 lin. ft. ditch and flume, and 4,438 lin. ft. of pipe, $23,779.53.

From the very interesting discussion which followed the reading of this paper by the author, we extract the following points:—As illustrating the durability of wrought-iron pipe, Mr. Smith mentioned two pipes, each 26 in. diameter made of No. 16 (.065 in.) iron, single riveted, and with a maximum tensile strain upon the iron of 11,500 lbs. per sq. in. These pipes were laid in 1868, and now seem nearly as good as new; though much sand and gravel is carried through them no wear is appreciable. The joint is generally made by placing a strip of tarred canvas around the smaller end and forcing the pipes together by a jack-screw; if they leak, pine wedges are driven in the joints. For heads of less than 300 ft. neither canvas or wedges are found necessary. The leakage is very slight.

With regard to the rusting of the iron, all pipes are thoroughly coated, inside and out, with a protecting mixture of asphalt, coal-tar, a little oil, and sometimes resin, if a hard surface is desired. The mixture is brought to a boiling temperature and the pipe allowed to remain in the bath about ten minutes, when it is laid on trestles and dried in the air and sun. The pipe of the Cherokee Mine is 13,000 ft. long, 30 in. diam, and is under a maximum head of 887 ft. It was laid in 1871, and is in perfect order. At the lowest point, the pipe-iron is ⅜ in. thick, double-riveted; the lightest iron is 1/16 in. thick; the highest tensile strain is 17,549 lbs. per square inch.

The Spring Valley Water Co. supplying San Francisco, has wrought-iron pipe laid 20 years ago; no signs of rust are perceptible. This company is now laying a pipe 5 ft. in diameter and 24 miles long, under a vertical head of 500 ft.

The statement that iron pipe will not rust when exposed to the pure air of Colorado or the Pacific coast, was denied by the author. The secret of preservation lay in bringing the pipe to the same temperature as the preserving mixture. Expansion joints are unnecessary on these pipes, although the water passing through may be at 73° and the outside temperature 100°.

Mr. Dorsey's paper on Structural Steel is the result of a long investigation into the relative merits of the different kinds of steel and wrought-iron for structural purposes.

The usual steel for structural purposes, is called in the United States and England, "mild steel," and by Krupp and most of the Germans, "homogeneous iron;" the last seem the most appropriate name. Its characteristics are greater ductility and malleability, and less tensile strength than hard or tool steel. There is no fixed dividing line between hard and mild steel. The English consumers rely rather upon the good reputation of the manufacturer and the physical tests made, than upon the chemical composition.

The British Admiralty tests for "mild steel," is to have an ultimate tensile strength of not less than 26 nor more than 30 tons (2,240 lbs.) per sq. in. of section, and an elongation of 20 per cent. in length of 8 in. It must stand bending, when heated to a low cherry-red and cooled in water of 82° F., to a curve of which the inner radius is one and one half times the thickness of the steel tested. Lloyd's Register tests are about the same. The Board of Trade calls for 26 to 28 tons, tensile strength, and an elongation of 20 per cent. in 10 in. for furnace plates. For the shell of boilers, 28 to 30 tons tensile strength, and same elongation.

The tendency of English engineers is to use steel still softer than that stated in preceeding tests. Some large builders will use nothing in their boilers over 26 tons tensile strength, and 20° elongation in 8 in. Two of the largest consumers in Central England advise the use of steel from 23 to 25 tons tensile strength, and 25° elongation in 8 in.

The Siemens-Martin, or open hearth steel, is preferred by nearly all English consumers for structural purposes; it is exclusively used for ship-building, being considered more reliable and uniform than Bessemer, which is principally used for railroad purposes.

From the experiments of Mr. Parker, of Lloyd's Register of England, the loss of steel plates in strength by punching is:

For	¼	in.	Plate,	loss of strength		8	per	cent.
"	⅜	"	"	"		18	"	"
"	½	"	"	"		26	"	"
"	⅝	"	"	"		28	"	"

Reaming or annealing after punching restores the lost strength.

There is much diversity of opinion as to the safe working load of mild steel, compared to wrought-iron. Some say that the weight, as compared with wrought-iron, can be reduced 40 per cent. (while the most conservative say 25 per cent.), and have a stronger and more reliable structure of steel than of iron.

The Board of Trade of Great Britain, limits the working strain in tension of wrought-iron to 5, and steel to 6½ tons per sq. in.

The New Forth Bridge, with its 1,700 ft. span, is being built of Siemens-Martin mild steel. It will require 42,000 tons.

Siemens-Martin steel, to stand the preceeding tests, can now be laid down in New York, freight, duty and insurance paid, at the following prices, viz:

Plates, ¼ in. and over in thickness, $0.03 per lb.
Girders, beams, etc..... ..... 0.03⅜ " "

Annual Report of the Department of City Works, made to Common Council of the City of Brooklyn, February 1, 1884. for the year, 1883.

The chief point of interest to the citizens of Brooklyn, in the present report, is the urgent need for a further extension of their works, and the detail of the manner in which the threatened water famine of last year was averted.

With a population, in 1884, of 626,000, an average daily supply of 36,000,000 gallons of water is demanded.

The minimum daily supply from all sources is now 31,000,000 gallons, while the average daily consumption for the months of July, August, and September, 1883, reached 38,000,000 gallons, the deficiency being made up from the driven-wells to be referred to at greater length.

Believing that the time has passed for simply tiding over immediate or remote emergencies, the Department recommends an increased supply commensurate with the prospective growth of the City of Brooklyn. Surveys and estimates have been accordingly made, with a view of adding at least 20,000,000 gallons to the daily supply. The bill, empowering the city authorities to extend the present works Eastward, has been approved by the mayor, and is now in the hands of Governor Cleveland.

Chief Engineer Robert Van Buren, reports the new Davidson Steam Pump in working order, and as having been run very successfully at a speed, and consequent delivery much in excess of its contract guarantee.

With an average daily consumption of 36,131,408 gallons, for the year 1883, the average daily consumption for the month of January 1884, rose to 40,800,000, gallons, mainly caused by the waste to prevent pipes from freezing; one day it reached 45,000,000, gallons. The past season of 1883 was the dryest experienced in the history of the Department, the total rain-fall being 37.10 inches. The storage basin was empty on September 9, and the storage reservoir at Ridgewood roservoir, was drawn down about 15 ft. As the consumption was in excess of the supply, Messrs. Andrews & Co. of New York, were authorized to make a test of their driven-well system; two stations were selected, and at the Spring Creek Station, 100 driven-wells, 2½ in. each, in diameter, delivered during a severe drought, over 6,000,000 gallons per day for 60 days. The ground-water was at no time lowered over 6½ ft. at the wells. It is estimated that these driven-wells, furnished in total, 8,460,292 gallons per day. The Chief Engineer promises a full report upon this new feature of water supply, after one year's test.

Engineer Van Buren, in speaking of the proposed new supply, recommends that $60,000,000 gallons per day be provided for, and the present reservoir be enlarged to 320,000,000 gallons capacity.

The present safe pumping capacity is only 45,000,000 gallons, with a reserve of 15,000,000 gallons; another pumping engine or engines, of 15,000,000 daily capacity should be erected at Ridgewood Engine House; two years would be required to erect the new plant, and three years to extend the reservoir.

The proposed extension east of Rockville Centre is designed to secure the additional water supply from the streams and ponds between Rockville centre and Massapequa Pond, about 10 miles beyond the present pumping works. A new conduit would have to be built. The estimated cost of the entire work is $3,122,386, and three and four years would be required to complete it. This estimate includes the extension east, to Massapequa Pond 53,800 lin. ft., enlarging the distributing reservoir, and increasing the pumping power at Ridgewood Engine House. If a new conduit is built from Ridgewood to Rockville Centre, as is desireable, $1,250.000 would have to be added to the above.

CORRESPONDENCE.

Construction of Race Courses.

HAVANA, MASON CO., ILL. April 22, 1884.

EDITOR ENGINEERING NEWS:

I notice in the last number of SURVEYING that John T. Desmond in answer to R. Swart about laying out a one-half mile race track gives the curve at the ends on a semicircle of 226.18 feet radius as 25° 32'. This is undoubtedly incorrect and would lead to material error in laying it out on that curve. It ought to read 25° 19' for curve. If the instrument was set at the center of the semicircle and the telescope directed to one end of the arc, you would have to turn off on the vernier 25° 19' to intercept 100 feet of arc. But if the instrument was set at the end of the arc, then you would only have to turn off on the vernier half as much, or 12° 39.5'. The curve for the end of the mile track ought to read 13° 44' instead of 13° 46'.

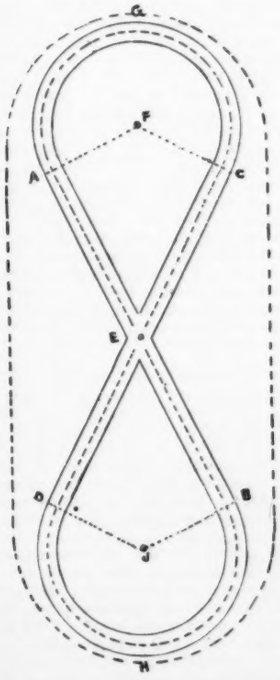
JOHN B. FRANKLIN, C. E.

Construction of Race Courses.

SAN FRANCISCO, CAL., May 10, 1884.

EDITOR ENGINEERING NEWS:—The correspondence in your last issue regarding the construction of Race Courses, recalls to my mind a suggestion once made to me by a sporting gentleman, namely, *to give to a race course the form of a figure 8.* Inclosed diagram illustrates the idea. The figure is truly symmetrical, and the middle (dotted) line represents the exact mile. The two tangents as well as the two curves are each a quarter of a mile in length The outer dotted line represents the usual form of race courses, is also one mile long, and drawn to the same scale. It is suggested that a light fence or barrier, be constructed upon the middle line, just sufficient to prevent the contending horses from interfering with, or "crowding" each other.

The advantages claimed for the "figure 8" track are: First, that neither horse would have the advantage of



keeping the inside track all the way around, for it is evident that the horse which has the inside track on the first curve must take the outside track on the second curve, and the other horse, *vice versa;* hence the distance actually run by both horses will be precisely the same; second, the amount of land required will be considerably less for the "figure 8" course, as will be apparent from inspection of the diagram; and third, it is claimed, that a horse changing from one curve to a reverse curve, will, in a measure, give a rest to certain muscles brought into constant play on curves running in one direction only.

In laying out a "figure 8" track, the radius of the curve and the angle it subtends must be ascertained by computation. The problem is somewhat intricate involving the use of the calculus. It is, however, a very neat problem, and I hope some of your mathematical contributers will try and tackle it. Should the correct solution fail to be forthcoming, I shall be pleased to furnish it. Respectfully,

G. F. ALLARDE, C. E.

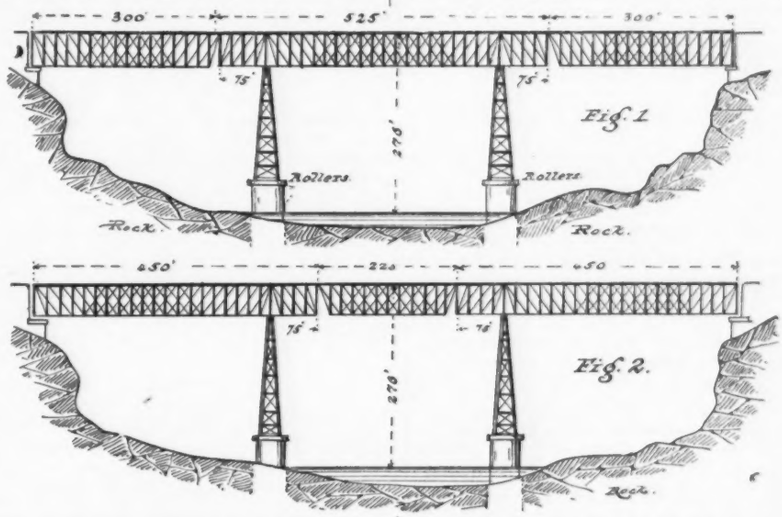
Cantilevers—What's in a Name?

Special Correspondence Engineering News.

BALTIMORE, MD., May 22, 1884.

EDITOR ENGINEERING NEWS:—My attention has been called to an editorial in the issue of May 17, in which it is stated that the new Niagara bridge is the *first true cantilever in America*, or words to that effect, and as there are always one or more dissenters to every opinion, I take the liberty of submitting the two diagrams below together with some remarks.

The first diagram shows Kentucky River bridge as finally built, and the second shows one of the many designs considered during the study of the problem, and I may say that this study began, with me at least, in 1867 when I was at Miami Bridge on the Ohio and Mississippi Railroads. In both diagrams I have omitted



the idle or slip joint sections of the bottom chords in order to more clearly isolate the skeletons.

The diagram of No. 2 was shelved for various reasons, deemed good in those more conservative days, and it seems to me that this arrangement is in substance the same as Niagara, barring the use of abutments as counterweights to help out the short shore spans.

I hope some engineer will formulate and publish definite reasons why a bracket projecting shoreward and carrying one end of a free span of bridge is not as good and *true* a cantilever as a similar bracket projecting riverward and carrying one end of a free span of bridge.

Truly yours,

FREDERICK H. SMITH,
Vice Pres. Balto. Bridge Co.

Oriental R. R. of Nicaragua.

Special Correspondence Engineering News.

[OFICINA DE LAS OBRAS PUBLICAS, DE LA REPUBLICA DE NICARAGUA.]
MANAGUA, April 19, 1884.

EDITOR ENGINEERING NEWS:—I am herewith authorized to make the following official announcement to you: In order to effect a thorough re-organization of the managing department of the Nicaraguan railroad, the Government has made the following nominations:

The Engineer of Public Works in charge of the *Oriental R. R. of Nicaragua*, under construction, THEO. E. HOCKE, to be General Manager, and José A. Roman, formerly Postmaster General, to be Superintendent; to take effect May 1, 1884. Don Max Sonnenstern retires from the superintendency.

Yours truly,

JULIUS WIEST,
Asst. Eng'r of Pub. Works.

American Petroleum Interests.

There are 20,000 producing oil wells in Pennsylvania, yielding at present 60,000 barrels of oil a day. It requires 5,000 miles of pipe line and 1,600 iron tanks of an average capacity of 25,000 barrels each to transport and store the oil and surplus stocks. There are now nearly 38,000,000 barrels of oil stored in the region in tanks. This oil would make a lake more than one mile square and ten feet deep. The money actually invested in petroleum production since 1860 is estimated to be more than $425,000,000, of which $200,000,000 was capital from New York city. Since 1880 more than $12,000,000 has been used in building iron tanks, and nearly as much in pipe lines, all by one corporation. The tanks cost on an average $8,000 each. A 35,000 barrel tank is 90 feet in diameter and 28 feet high. There is a lateral pressure of 6,000 pounds on each square inch of a tank of this size when full of oil. There is 100 tons of iron used in constructing one.

The speculative transactions in petroleum represent more than $400,000,000 annually. The lowest price crude petroleum ever brought was 10 cents a barrel in 1861. In 1859, when there was only one well in existence Col. Drake's Pioneer at Titusville, the price was $24 a barrel. Besides the 5,000 miles of pipe line in use in the oil regions there are in operation 1,200 miles of trunk pipe lines connecting the region with Cleveland, Pittsburgh, Buffalo, and New York, and lines building to Philadelphia and Baltimore. In the line between Olean and New York 16,000 barrels of oil are transported daily. These lines are all the property of the Standard Oil Company, except one between Bradford and Williamsport, Pa. The Standard employs 100,000 men. The product of its refineries requires the making of 25,000 oak barrels of forty gallons each, and 100,000 tin cans holding five gallons each, every day. The first American petroleum ever exported was in 1862. Charles Lockart of Pittsburgh sent nearly 600,000 gallons to Europe in that year and sold it for $2,000 less than the cost of transportation. In 1883 nearly 400,000,000 gallons were exported, for which $60,000,000 were returned to this country.—*N. Y. Sun.*

Smoke Products.

REED CITY, Mich., May 21.—The old saying that nothing is wasted or lost in nature is true in regard to the smoke from the furnace at Elk Rapids. In this furnace are manufactured fifty tons of chaacoal per day. There are twenty-five charcoal pits constructed of brick. Each pit is filled with one hundred cords of hard wood and then fired. The vast amount of smoke from these pits, which was formerly lost in the air, is now utilized. Works have been erected to convert the smoke into chemicals and acids. These works are a curiosity. First, they have a circular tube made of wood, with pine staves, sixteen feet in length, bound together with heavy iron hoops. This tube is placed directly over the pits in a horizontal position, with an opening from each pit into the tube. At the end nearest the building there is a large drum containing a rotary fan propelled by machinery, the power of which is gas. That acts as a suction or draught for the smoke, which is conveyed into five stills filled with copper pipe, 2½ inches in diameter.

The boxes in which the pipes are situated are 20 ft. square, 8 ft. deep, made of heavy pine, and filled with cold water; these are all connected by copper pipes; they are connected with the

main still, 100 ft. in length, 10 ft. wide, and 8 ft. deep, filled with copper pipes, 2½ inches in diameter, in a horizontal position surrounded with cold water; from this conveyed to a purifier, from which runs what is called pyroligneous acid, which is as clear as amber, with an unpleasant odor. From the acid is produced, first, acetate of lime; second, alcohol; third, tar; fourth, gas, which is consumed under the boilers. Each chord of wood contains 28,000 cu. ft. of smoke: 2,800,000 ft. of smoke handled every twenty-four hours, producing 12,000 pounds of acetate of lime, 200 gallons of alcohol, and 25 pounds of tar. These articles have a commercial value in the manufacturing of various articles. The smoke from 40,000 cords of wood consumed per annum is thus made a source of much profit, as the works are nearly automatic, and require no workmen to run them.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

B. J. JAMES R. CROES, M. AM. SOC. C. E. : M. INST. C. E.

(*Continued from page 262*)

DCXLII. BUCYRUS, O.

Bucyrus, Ohio, in lat. 40° 40′ N., long. 94° W., the county seat of Crawford County, is in a generally level and fertile farming district on the Sandusky River.

Settled in 1882 it was incorporated a village in 1833. Water-works were built in 1883 and 1884, having been completed in February in the latter year, by a private company taking the supply from ground water. From a well 50 ft. in diameter and 20 ft. deep, yielding 700,000 gallons daily, the water is pumped by two pumps of 14 in. steam and 8½ in. water cylinders and 12 in. stroke made by M. Walker, directly into the mains, giving an ordinary pressure of 45 lbs., and a fire pressure of 120 lbs.

Distribution is by 10 miles of Wyckoff wooden pipe of 12 to 4 in. diameter with 74 fire hydrants for which the village pays $4,380 yearly. Service pipes are of lead and Wyckoff wood. The works have so recently been completed that the number of taps cannot be given. The population in 1880 was 3,825, it is now said to be 5,000.

The capital stock of the company is $80,000, and its bonded debt $50,000 at 6 per cent. The works have cost $66,000. James B. Gormly is President and John A. Eaton, Secretary.

DCXLIII, BOONVILLE, MO.

Boonville, Missouri, in lat. 39° N., long. 92° 30′ W., the county seat of Cooper County, is on the South bank of the Missouri River, in the midst of a rich farming and coal and iron mining region. It was settled about 1800 by Daniel Boone.

Water-works were built in 1883 by a private company, after plans of B. P. Perkins, taking the supply from the Missouri River.

The water is pumped by two Smith and Vaile pumps of 18 in. steam and 16 in. water cylinder and 10 in. stroke, to two reservoirs constructed in earth embankment lined inside with cement, 80 and 140 ft. above the city, and each holding 1,500,000 gallons. After settling, the water is filtered through gravel between two brick walls. These reservoirs furnish the ordinary pressure which is about 45 lbs. For fire pressure a tank is erected 50 ft. higher than the reservoirs, having a capacity of 60,000 gallons, and giving a pressure on the mains of from 60 to 75 lbs.

Distribution is by 5½ miles of cast-iron pipe from 10 to 4 in. diameter, with 50 fire hydrants and 14 gates. The city pays $60 per year for each hydrant. Service pipes are of wrought-iron. The works have just gone into operation and the number of taps cannot be given.

The population in 1880 was 3,854 and is now said to be 5000. The capital stock of the company is $100,000.

No further financial statement is made.

The works are managed by a board of directors; John S Elliott is President, and R. Hadelich, Superintendent.

DCXLIV, BROCKVILLE, ONT.

Brockville, Ontario, in lat. 44° 32 N., long. 75° 40′ W., is on the St. Lawrence River, at the foot of the Thousand Islands, and is extensively engaged in the manufacture of hardware.

Water-works were designed and built in 1883 by J. B. A. Béique, the supply being taken from the river, which at this point is 2½ miles wide. A crib 30 by 25 ft. and 42½ ft. deep is built 425 ft. from the low water mark, and from it an iron suction pipe 16 in. in diameter, with flexible joints carries the water to a pump well 12 ft. deep and 8 ft. in diameter.

The end of the section pipe is provided with a screen of 1 in. iron bars and ¼ in. galvanized wire gauze. From the well the water is pumped by a compound condensing Holly pump, with a capacity of 2,000,000 gallons daily, directly into the mains. The ordinary pressure is 50 lbs., and the fire pressure 75 lbs.

Distribution is by 10 miles of cast-iron pipe, coated inside and out, of 12 to 2 in. diameter, with 106 fire hydrants, 32 gates and about 3,500 taps. Service pipes are of lead. The city pays $50 yearly for each hydrant. The population in 1883 was 9,800.

The cost of the works has been about $185,000. The capital stock is $280,000, all being owned by J. B. A. Béique. E. O. Overell is Manager.

WATER.

We want *all the news* concerning water supply that we can obtain. To *any* person mailing us early intelligence of such, either in the shape of correspondence, reports, or newspaper clippings, we will mail a copy of Croes' Statistics of American Water-works.

WORK has commenced on the Paola, Kan., water works.

ODEBOLT, Iowa, is to have water works. Contract is let. Fairfield, Iowa, is putting in water works.

THE new water-works of Bucyrus, O., were partially tested on the 15th.

THE contracts for building the reservoir dam and laying the pipes for the Plainville Water Company have been duly executed and the work has already commenced. The dam is be built by Charles W Blakeslee & Son, of New Haven, and the pipe is to be furnished and laid by the Connecticut Water Pipe Company, also of New Haven. The plans and specifications for the works were furnished by Captain D. Goffe Phipps, of the "Connecticut Patent Water Pipe Company.

STATE Engineer E. S. Nettleton has issued the following letter to the Water Commissioners throughout the State :

DENVER, COLO., May 17, 1884.

To Water Commissioner——District:

Sir:—There is but little doubt that the waters of the streams in Northern Colorado will, within the next forty days, reach a higher point than has been reached in several years, and, as a consequence, considerable damage will most likely to occur to head-works of canals, bridges and lands on these rivers, I would suggest that you immediately take some steps to notify the owners of canals to proceed at once to protect as much as possible of their property against the damage which would result from an early and high stage of water.

When the necessity comes for irrigation, all Canal Superintendents should be encouraged to take all the water his ditch or canal will carry, thus relieving the main stream.

I would also suggest that your County Commissioners provide for keeping pile bridges free from drift wood.

Respectfully,

E. S. NETTLETON,
State Engineer.

ONE of the largest buildings now in the course of erection in this city, is the new Potter building to replace the one burned down two years ago. It is mostly of iron. We have occasion to pass it several times every day, and have been much interested in watching the ease with which the great iron girders for the floors are handled by means of the Terhune automatic trucks. In times past it required many men and ropes and considerable noise to move such heavy bodies; now one of these convenient machines is run along over the girders which is at once gripped; two additional men steady and guide the load as it is pushed to the hoisting place; there is no noise, fuss, or heavy lifting, and the building operations progress literally without noise, as we read of when Solomon was in the building business. We are certain that where this convenient apparatus becomes known its use will eventually follow. They are manufactured by the Automatic Truck Works at Midland Park, N. J.

THE House bill for Middleboro, Mass., water supply has passed to be engrossed.

COLORADO, Tex., May 17.—The Colorado and Seven Wells Water Company closed a contract to-day with the Holly Manufacturing Company, of New York, for the construction of their waterworks, which are to be completed within six months. It will be a first-class system of waterworks and will add largely to values in this city. The president of the company is J. Richardson, one of the wealthiest capitalists of New York, and N. A. Taylor is secretary. The success of the enterprise is chiefly due to the uniting energy of the latter.

IN less than two months Kensington will draw its water supply from the Schuylkill. The change from Schuylkill to Delaware water for the Kensington district is one of the most important of the progressive steps made under the present management of the Water Department. Schuylkill water is nothing to boast of, but water polluted by the city's sewage, carried into the Delaware, is far worse. If Councils and citizens will support Chief Engineer Ludlow, Philadelphia may yet enjoy the blessing of a permanent and abundant supply of pure water. The surveys made by Mr. Ludlow demonstrate the feasibility of tapping the Delaware above Trenton for a temporary supply. The final plan, which contemplates the extension of an aqueduct to the upper Delaware, could be accomplished with the accumulation of funds, but, with the Delaware between Trenton and Easton once reached, the project could rest until the city could afford to push the work ahead, and, in the meantime, Philadelphia would enjoy a water supply ample for all temporary needs! The approach of the summer season, with its usual droughts, is likely to again demonstrate the urgent need of defining some plan, and keeping the object—an abundance of pure water—steadily in view until it is accomplished.—*Philadelphia Press*, May 21.

A QUEER FISH-POND.—On top of the *Record* building, 90 ft. from the ground, is a water tank with a capacity of 18,000 gallons. It was never thought of as a source of fish supply, but a recent discovery has suggested almost unlimited possibilities in that direction. The other day the engineer had occasion to clean out the tank, when he was amazed to find in one of his buckets a squirming eel, 9 in. long and of fair proportions. In a few minutes he found other fish in his bucket, a catfish 4 in. long, and more eels, until he had a fair collection, which he carefully preserved. A fishing pond nearly 100 ft. above the ground is a novel affair, and this singular "catch" from the *Record's* roof has provoked a great deal of curiosity and speculation. The water is pumped into the tank from the water main on Chestnut Street, coming into the three-inch pipe of the *Record* through an inch connecting pipe. It then passes to the force pump and is forced 100 ft. into the tank above through a three-inch pipe. The fish probably came from the Schuylkill while very young and small, and found their devious ways to the tank, where they grew up. What they fed upon is a mystery, and the proof-reader, who usually spends five hours every week in baiting his hook for Wissahickon catfish, will now look for mountain trout on the *Record's* roof.—*Philadelphia Record.*

WATER AND DRAINAGE IN MEXICO.—The public buildings of Mexico are too interesting to pass with a word. But while inquiring into the surroundings of the people of this great city, something should be said about the water supply and drainage, on which, to so great an extent, public health depends. In the modern sense, Mexico has neither of these essentials of comfortable existence. There is absolutely no distribution of water through houses and other buildings as we have it at home. Two aqueducts bring water of unquestioned purity to the city. By those who have the means, the fluid is always filtered before it is used. There are numerous public fountains. From these the water is carried for 1 cent to 12½ cents a load by cartmen or porters to those who want it for domestic or other purposes. One of the most common sights in the squares of every Mexican city is a group of men, women and children, of various ages, but the same condition of raggedness, about a fountain, scooping up the water with ladles, or lowering their earthen vessels into it.

The use of water being thus limited, there could of course be no thorough flushing of sewers, even if the drains had sufficient slope to permit of a steady current. But, owing to the situation of the city on a plain which is surrounded by lakes on nearly the same level, or even higher, there is no flow through the few sewers in existence. Hence these are mere cesspools. In consequence of this shocking state of affairs, the city is very unhealthy. Fevers of every kind, and other zymotic diseases, are a constant scourge. Between 1879 and 1883 the annual death rate rose from 8,000 to 13,000. The city would be almost uninhabitable but for its highness and dryness, which counteracts, to a very great extent, the evils of non-drainage. Still the importance of draining the valley, and with it the city, has been fully realized for several hundred years. By common consent the engineering problem involved therein is one of the most interesting ever raised.—*St. Louis Globe-Democrat.*

NEWS OF THE WEEK.

Railroads and Canals.

THE line of the Atlantic and Danville Railway through Sussex County, Va., has been at last determined upon, and work commenced on the line. It will run direct from Waverly to the court house, passing within one mile of it, and hence direct to Hickford. The entire distance will be about thirty-five miles. Sussex County pays the company $3,500 per mile to help build the road, which will make her subscription $122,500.

EX-GOVERNOR FOSTER, of Ohio, is in Washington, conferring with capitalists, with a view to forming a company to construct a railroad from St. Louis to Utah. The road to be built will be known as the St. Louis, Kansas City & Western, of which Mr. Foster is to be President, and Mr. H. C. Cross, of Emporia, Kansas, the Vice-president. The road is to run from St. Louis to Kansas City, through the coal fields of Bates County, Missouri, Emporia, Kansas, Pueblo, Denver, Leadville and to a point between Colorada and Utah. Articles of incorporation have already been filed with the Secretary of State of Kansas. The capital stock of the company is $50,000,000. Among the directors are Ex-Governor Foster, Senator Miller, of New York, and the Hon. Amos Townsend, of Cleveland.—Denver *Tribune*.

BEWARE OF HIM.—Girls ought to be warned of the frightful danger to be incurred in marrying railroad men, especially brakemen. There are many stories told of the laughable eccentricities of railroad men during their moments of sleep, but a story comes from a Western city which is quite laughable indeed. It is related that a few nights ago a member of the hard-working fraternity, on being roused from a dream of an impending crash, was found by the neighbors sitting up in bed holding his wife by the ears, having nearly twisted the terrified woman's head off in his ineffectual exertions to "down brakes."

A DIVIDEND DID IT.—"When the war closed one of the Georgia railroads hadn't a depot or freight house on its line, and its rolling-stock consisted of two old locomotives and four flat cars. These couldn't roll until new ties and rails were laid, and the outlook was dubious enough. However, the President called a meeting of the board to see what could be done. When he had stated the condition of the track and equipment he added that the company hadn't a dollar in cash, and no collateral to borrow money on. He then asked what should be done.

"'I move we declare a dividend of 10 per cent.,' boldly replied one of the directors.

"It was a thunderclap which knocked 'em all down; but he followed it up by offering to loan the company $32,000 to make the dividend, and a dividend was decided on. The stock at once leaped from 34 to 90 cents, and in a year it was held at 108 and paying dividends on that."—Wall Street *News*.

IMPROVEMENTS AT BUFFALO.—There is hardly any property left in Buffalo available for shipping purposes which has not been secured by one or the other of large corporations centering there, and, although the New York Central had a large amount of track room and owned the property on Coit Slip and Slip No. 2, it has begun buying all the water front from the vicinity of this property down the river to Pennsylvania Street. This property extends far into the water, sometimes to the distance of over 1,000 ft., and it is proposed to build a system of docks extending far out into the rivers, so that vessels may come up at right angles instead of alongside. This will be done by dredging channels alongside. Each slip will float a row of vessels on each side and be wide enough for coal trestles and ware-houses as well as tracks.

Even with improvements extensive as are projected with the Central, it is doubtful if they can secure as fine a dock system as that which the Lehigh Valley has been perfecting for the last two years on the Tift Farm. The territory is about a mile square, from the Lake shore on the east and to the track of the Buffalo Creek south to the lake. The whole system comprises six canals, about 2,000 ft. long, with docks between, about 600 ft. wide, with the necessary trestles. At present three channels have been dug with an aggregate length of a mile and a half and one trestle of about 1,000 ft. in length, with 800 ft. of dock already completed and the piling is down to solid rock 60 to 85 ft. The main canal will be utilized this summer for lumber piling. The second is pretty well forward and a third is practically finished. It is expected that it will take fully two years to complete the work already begun.

ARTICLES of incorporation for the Bruff rapid transit railroad will be taken to Albany this week. The present Board of Trustees are named as the directors. The estimated cost of the superstructure is $800,000, and of the whole road $1,500,000. It is said that $2,000,000 has already been subscribed.

ELDORADO, KANSAS, May 21.—The Eldorado, Newton and McPherson Railway company has been organized and a charter applied for. The capital stock is $2,000,000. The length of the proposed road from Eldorado to Ellsworth is 110 miles. The line, if built, will be virtually an extension of the St. Louis, Fort Scott and Wichita road northwest through the counties named. It is a well backed enterprise and will be built.

THE Louisville (Ky.) Short-route Elevated Railway, just completed, is intended principally for the use of the Chesapeake and Ohio, and Chesapeake, Ohio and South Western Railroads, and as a transfer and common highway for all the roads in Louisville. C. P. Huntington is the principal stock holder. Work was commenced in June 1883, the entire viaduct is 5,600 ft. long; it is made of 30 ft. plate girders, mainly resting upon iron columns. There are 484 foundation piers, 572 plate girders, and 39 tower spans. The heaviest grade is 73 ft. per mile. There are 9,000 cu. yds. of excavation in the foundations, some of these being 40 ft. below the surface; 4,000 cu. yds. of masonry, and 3,000 cu. yds. concrete; 1,000,000 ft. B.M. of timber were used in the ties and guard rails; the rails weighed 60 lb. per yd. The sharpest curve is 10 deg.

The iron work was done by the Phœnix Bridge Works, and J. T. B. Hillhouse was the engineer in charge.

THE New York *Tribune* of May 18, says: "General Meigs, the greatest authority on military railway construction in the United States, shows that the Mexican Central Railway has been laid at the rate of nearly a mile a day, and asks why the British government cannot do as well, or even better, between the Red Sea and the Nile. They would have to do much better than this in order to rescue General Gordon. The distance from Suakim to Berber is 250 miles, and General Gordon cannot be expected to hold his ground 250 days. One thing, however, must not be forgotten. The news that the British were building such a railway would travel fast. Before the first section of fifty miles could be completed, the Soudanese on the Nile would be convinced that the British were in earnest, and they might be disposed either to declare for General Gordon or to disperse quietly. General Meigs say nothing about the climate of the Soudan, which would probably prove a greater obstacle to railway construction than the engineering difficulties. Major Clarke, who has had great experience in railway building in India, ridicules in the London press the idea that the project is impracticable on account of the heat. He has built railways with a mean monthly temperature of 92 degrees Fahrenheit, night and day, and laughs at the excuse that it will be too hot during the summer to proceed with this work in the Soudan. Well informed experts in England are confident that such a line would not only prove of the utmost importance in a military sense, but would ultimately be a profitable enterprise, since 100,000 tons of freight already finds its way down the Nile."

WAYNESVILLE, N. C., May 21.—The Ducktown Division of the Western North Carolina Railroad has been completed to the summit of Great Mountain, the highest point on the line, and will be open for through business to Murphy by August. From Murphy a line will be extended to Atlanta and a branch to connect with the Louisville and Nashville system of roads, thus rendering the Richmond and Danville, of which the Western North Carolina is a portion, entirely independent of the East Tennessee, Virginia and Georgia Railroad branch from Morristown, Tenn., to Asheville. This division is one of the most important railway enterprises now in progress in North Carolina, and is backed up by New York capitalists to the amount of $2,000,000. With the proposed railroad to be built by the Baltimore and Ohio Company from Roanoke to Asheville, there will be established an air line from Baltimore to Atlanta and to Louisville and St. Louis some two hundred miles shorter than either the Richmond and Danville Piedmont Line or the Virginia and Tennessee Air Line, as they exist at present. The new road is laid with 67-pound steel rails of the best quality. Ex-President Buford, of the Richmond and Danville, says that this new line will be one of the most important branches of the Clyde system. The work is done under the immediate supervision of Colonel A. B. Andrews, president of the Western North Carolina Railway Company and superintendent of the North Carolina Railroad.

IMPORTANT RAILROAD NEWS IF TRUE.—The Santa Fe *Review* has been fortunate enough to secure positive information that the vigorous, progressive policy of the Atchison, Topeka & Santa Fe hinted at in these columns some weeks ago, is shortly to be inaugurated in New Mexico by constructing of a number of important branch lines radiating from the main line at various points and penetrating the best sections of the mineral and pastoral region of the territory. The original character of the New Mexico Railroad Company authorizes the construction of no less than twenty-two separate branch lines in this territory, and it is gratifying to be able to state that the Directors of the Atchison, Topeka & Santa Fe, who hold this charter have, within a few months past decided to carry out the original intention of the incorporation and complete the several lines called for in this charter within three years' time. In other words, they propose from this time forward to keep a large force actively engaged in railroad building in New Mexico. The Lake Valley branch has just been finished, and is in full running order; the Magdalena branch is rapidly nearing completion, and immediately following the same will come the work of constructing the Jemez branch from Bernalillo. This is one of the most important new lines contemplated for it will penetrate a splendid country, develop a large area of grazing land, open up some excellent mines, and attract a large travel from tourists and invalids desirous of testing the wonderful effects of the Jemez Hot Springs. The company's chief idea in constructing this branch, however, is to render accessible the vast forest that exists in that vicinity of the Rio Grande valley. The White Oaks branch will be commenced about the same time, the line b ing extended from San Antonio, the present terminus, through a rich coal and mineral region to the town of White Oaks. Surveys for both of these lines have been completed, and others for various additional branches are now in progress. From the information at hand the *Review* confidently expects to hear that dirt has commenced to fly on both of these branches within sixty days.—Denver *Tribune*.

THE *Railway Age*, of Chicago, has been accustomed, for several years past, to compile a full statement of railroad construction in the United States after the close of each year. The statement for 1883 has just been published by the *Age*, and the results are given in the following table:

	Roads.	Miles.
New England States.		
Maine	6	41.2
N. Hampshire	..	....
Vermont	2	22.0
Massachusetts	4	18.0
Rhode Island	..	....
Connecticut	1	3.0
Eastern Middle States.		
New York	10	399.2
New Jersey	2	7.5
Pennsylvania	26	363.5
Maryland and D. C.	..	....
Middle Western States.		
Ohio	15	349.0
Indiana	7	180.3
Michigan	16	421.3
Illinois	11	174.7
Wisconsin	10	218.8
Pacific Belt.		
California	6	251.0
Nevada	..	....
Oregon	5	196.3
Arizona	2	156.0
Idaho	2	282.0
Washington T'y.	4	161.0
Southern States.		
Virginia	7	98.1
N. Carolina	4	52.0
S. Carolina	2	40.5
Georgia	6	65 5
Florida	7	245.2
Alabama	4	181.0
Mississippi	5	362.1
Tennessee	4	40.0
Kentucky	6	127.6
Missouri Belt.		
Minnesota	8	167.5
Iowa	8	231.4
Arkansas	8	198.5
Louisiana	6	238.1
Kansas Belt.		
Dakota	11	410.8
Nebraska	9	199.2
Kansas	6	144.0
Indian Territ'y.	2	12.0
Texas	7	68.5
Colorado Belt.		
Colorado	9	88.8
Montana	4	413.0
New Mexico	3	81.0
Utah	2	160.0
Wyoming	..	....

The following table is a recapitulation of the above:

	Roads.	Miles.
New England States	13	84.2
Eastern Middle States	38	770.2
Middle Western States	59	1,344.1
Southern States	45	1,313.0
Pacific Belt	19	1,046.3
Missouri Belt	20	835.5
Kansas Belt	35	834.5
Colorado Belt	18	742.8
Totals	257	6,969.6

"It will be seen that track-laying was carried on during the year in almost every one of the States and territories—the only exceptions being New Hampshire, Rhode Island, Maryland and Wyoming—on some 257 lines, and that, while the mileage is much less than that of the previous extraordinary year of railway building, it was still very large. In fact, it was much greater than in any previous year of the past decade, with the exception of the years 1880, 1881 and 1882, in which years 7,174 miles, 9,784 miles and 11,591 miles were laid respectively. The total railway mileage of the United States on December 31, 1883, was in round numbers 120,200 miles. It is possible that these figures should be slightly increased, but our researches indicate them to be complete."

Contracting Miscellany.

THE contract for the erection of a new Court-House in Griggs county Dakota, has been let at $20,870.

CONTRACTS have just been let covering the first ten miles on the Georgia Pacific extension from Birmingham, Ala., to Columbus, Miss.

This distance embraces some very heavy work, one or two tunnels, and a large outlay in bridges. This grading is to be completed by October.

IN the case of Joseph S. Mundy, of Newark, N. J., against the Lidgerwood Manufacturing Company (limited) for infringement of patent granted said Mundy July 13, 1880, for an improvement in friction drums for pile drivers and hoisting machines, the U. S. Court of the Southern District of New York, has decided in favor of Mundy and so decreed May 5th.

M. E. BELL, U.S. Supervising Architect, at Washington, D.C., advertises for proposals to be opened June 16, 1884, for tile floor arches, furring for cornices, and covering for iron columns at Buffalo, N. Y.; Toledo, Ohio; Quincy, Ills., and Peoria, Ills. Bids must be accompanied by a certified check, and those received after the time of opening will not be considered. Tenders will also be received for steam heating apparatus at Kansas City, Mo., to June 24th, 1884.

THE contract for construction of the Franklin & Megantic Railroad was awarded to Charles H. Sawyer of Bangor, Me., on the 22d. The contractor will commence work with a large force as soon as the locating now in progress has sufficiently advanced. The construction will be pushed as rapidly as possible that the road may be in condition to accommodate the sporting travel and movement of lumbering supplies into the Dead River region this fall. The Chief Engineer, now engaged in locating the line, is Frederic Danforth, of Gardiner, Me., with O. H. Tripp and J. L. Colcord as 1st and 2d Assts.

The address of the Chief Engineer is Strong, Me.

WASHINGTON, May 22.—Congressional Legislation for the Cœur d'Alene country is still being attempted. Delegate Singiser has introduced a bill to incorporate the Belknap and Cœur d'Alene Toll road Company, which if passed will probably levy tribute on the few victims of the mining excitement who find themselves able to stay in the country. Howard C. Chapin, Amos P. Curry and Henry W. Dixon are among the leaders in the scheme. They propose to make a roadway from the line of the Northern Pacific, at Belknap, up Pritchard creek to the head of navigation on the Eagle in Idaho Territory. The capital stock is to be $100,000, and authority is asked to mortgage the franchises, etc., to the amount of $50,000. The price of toll to be charged is not mentioned.

The McHenry Gulch Consolidated Mining and Tunnel Company, composed of the Lovell, McHenry and Hawkeye Mining Companies, want Congressional encouragement for a great work they are about to undertake in Wasatch County. They suggest that to encourage the excavation of a tunnel 15,000 feet in length, more or less, designed to drain the Ontario silver mine to a depth of 1,400 feet, all the land for the entire length of said tunnel, and for 1,500 feet on either side of the proposed line, together with all the minerals it may contain, the title of which is not already vested, shall be given to the company. The excavation for the tunnel is to be begun within three months after the approval of the act, and the Secretary of the Interior is to hold back the land grant until two-thirds of it is completed. If at the end of five years the work has not progressed that far the grant is to lapse. The Committee on Mines and Mining has the matter under consideration.

Secretary Teller has had once more to decide how long six months is in the business of the Interior department. The case came to him from Dakota. It was a claim to land under the regular laws in which the first applicant had made his entry March 11, 1882, and the second on September 12, of the same year. The second applicant argued that his predecessor had abandoned the land for six months and it was, therefore, open to settlers, as if it had never been occupied. The suit grew complicated, but on the point of the time the Land Commissioner held that the six months absence had taken place before the second application was filed. Secretary Teller says that ruling is in error. In order to complete the time, the whole of the additional day must be taken, and in this case the land was not open to a second claim until after September 12.—*Cor. of the Denver Tribune.*

WAXAHACHIE, TEX., May 19.—An enthusiastic railroad mass-meeting was held at the Court-House Saturday night, the object of which was to devise plans to connect their point with the Gulf, Colorado and Santa Fe railway. The meeting was largely attended by representative citizens, speeches were delivered, and a proposition made to levy a tax of fifty cents on all real estate and personal property was favored with the signature of the entire meeting. John G. Williams, H. H. Dunn, A. Trippert, John C. Gibson, N. A. McMillan and J. W. Ferris constitute the executive committee, who take steps to procure a charter and means to push the road through at an early day.

HEARNE, Texas, May 19.—A mass-meeting of the citizens of this precinct was held in the Opera-house to-night, at which a resolution was adopted condemning the action of the Commissioners Court in passing an order to issue bonds in the sum of $25,000 for a bridge across the Brazos river, near Calvert, and $5,000 towards waterworks at Franklin. An executive committee, consisting of D. P. Gay, B. W. Beckham, W. T. Watt and F. H. Bailey, were elected and empowered to secure legal aid in testing the constitutional right of the Commissioners Court to issue said bonds.

The meeting was largely attended, and all were unanimous in expressing their opinion of the injustice and the outrageous manner in which the rights of the tax-payers of Robertson county are sought to be made subservient to the business interests of a few citizens of Calvert.

Bridges, Tunnels, Etc.

THE Probate Court of Jefferson Co., Ala, of which the progressive City of Birmingham is the capital, is preparing to let contracts for five or six iron bridges along these highways. These structures are demanded by the rapid mineral development which this section is now undergoing.

THE Senate passed thirteen bills for the erection of public buildings, the amount appropriated being $1,442,500. Bills were passed to authorize the bridging of the Mississippi at Sibley, Missouri, and at some point between St. Paul and Natchez; to bridge the Missouri at Rulo and White Cloud, Kansas, and at the mouth of the Ducetah, and to bridge the Illinois between its mouth and Peoria.

MONSTER RUSSIAN BRIDGE.—It is reported from Russia that the question is being agitated of connecting Cronstadt and Oranienbaum by a bridge at a cost of 2,400,000*l*. The structure is to rest upon granite pillars fixed by the caisson method, each of them protected from the action of the waves during the prevalence of south-west winds by an angular wall-like guard of stone. The bridge will be about five miles in length, and it is expected to be completed by 1889. When finished—if it ever is finished—it will consist of two parts, a railway and a foot-bridge.

THE Union Bridge Company, of New York and Buffalo, has recently taken contracts for a single-track railroad bridge over the St. Croix River, near Stillwater, Wis., to have 10 spans of 159 feet each, and 25 of 30 feet each; a bridge over the Arkansas river at Van Buren, Ark., for the St. Louis and San Francisco road, to have a draw-span 370 feet long, and 5 fixed spans of 252 feet each; and a railroad bridge over the Arkansas River at Little Rock, Ark., to have a draw-span 365 feet long, and 3 fixed spans of 253 feet each. The new work recently taken is equal to 15,840 feet of bridge, or about 3 miles of single track.

SINCE 1863 the Keystone Bridge Company have erected 30 miles of bridges and viaducts, among which are a steel arch bridge over the Mississippi River at St. Louis, a double-track and double-deck bridge for highway and railway purposes in 3 spans, one of 520 feet, and two others of 502 feet each; a steel-truss bridge across the Missouri River at Plattsmouth, Neb., for the Burlington and Missouri River Railway, in 2 spans of 400 feet each; an iron-truss bridge over the Ohio at Cincinnati, a very fine bridge of 519 foot span; and an iron draw-bridge over Raritan Bay, on the New York and Long Branch Railway, in one span of 472 feet. Steel bridges are rapidly coming to the front and the company are now engaged on two—one to cross the Ohio River at Point Pleasant, and the other for the Mississippi River in Nebraska. In addition, there was a large drawbridge for New York in course of construction. The firm, of which Mr. A. Gottlieb, C. E., is the president, employ on the works 600 hands, and a further 350 are generally in the fields erecting work. The workshops cover 3 acres, are brilliantly lighted by electricity, and are run night and day. About $1,000,000 is invested in them, and they are nearly all fire-proof.

The Philadelphia Cable Railway.

The Philadelphia Traction Company, at a meeting of the West Philadelphia Passenger Railway stockholders on May 12, obtained a lease of the road for 999 years, and as soon almost as the document was executed the machinery for the cable road was started upon. The Traction Company, which is composed chiefly of William H. Kemble, Peter A. B. Widener, William L. Elkins, George R. Yarrow, George W. Elkins and George D. Widener, has made an agreement to apply the cable system to the Chestnut and Walnut Streets line, the Market Street line and the line to Darby. At present work is being done only on Market Street and on the Union tracks up Franklin Street to Columbia Avenue. The cables will be set in motion on these thoroughfares first of all, and then the other branches, which the Traction people have engaged, will undergo the change.

The Philadelphia Traction Company has a capital of $5,000,000. The cost of building a cable road is said to range from $40,000 to $125,000 a mile. The expenditure is influenced by the style of construction, the nature of the soil and the grades. In Chicago the cost was about $115,000 per mile, but in that city there were exceptional difficulties to be overcome. The ground was soft and yielding and the iron tunnels could only be prevented from sinking by a heavy bed of concrete. In San Francisco the conditions were much more favorable. The cost of placing three miles of cable road there was $155,698. To this, however, must be added the cost of equipping the road with engines, boilers, cables and everything requisite, which was $86,080, making the grand total for three miles of cable road in running order $241,788.

Assuming that the cars and dummies on a three-mile cable road run at the rate of six miles an hour, with a headway of five minutes, each car and dummy accommodating forty-four passengers (the capacity is twice as large as that of an ordinary car, the space taken up in the latter case by the horses being filled by the dummy), the annual running expense would be $59,085. If the same road were operated with horses running at the rate of four and one-half miles an hour, each car only accommodating twenty-two passengers, the headway would have to be two and one-half minutes. The cost with horses would be $138,880 per annum. It will thus be seen that the saving through the cable system on the three-mile road would be $79,794 per annum, or within a fraction of 57½ per cent.—*Philadelphia Press.*

Mails to Mexico by Rail.

WASHINGTON, May 23.—The Railway Mail Bureau has completed the schedule for the mail service between points in the United States and the City of Mexico. The service will be daily, and the running time between New York and the City of Mexico will be six days, twenty-three hours and ten minutes while the return trip will be made in seven days, one hour and twenty minutes. The distance is 3,749 miles, 1,224 miles of the railroad being in Mexico. Starting from New York at 8 A.M., the mails will arrive in the City of Mexico at 7.10 A.M. Coming northward, the mail will leave Mexico at 9 P.M., reaching New York at 10.20 P.M. The following named cities are on the line of communication: Pittsburgh, Columbus (Ohio), Indianapolis, St. Louis, Sedalia, Kansas City, La Junta, Albuquerque, Rincon, and El Paso.

H. E. LONG, president of the Duluth, North Shore and Southwestern company, says the Surveyors have been recalled from the work of locating the line, and for the present at least, all work is suspended.